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Chattanooga TN 37401

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Volume II: Appendices

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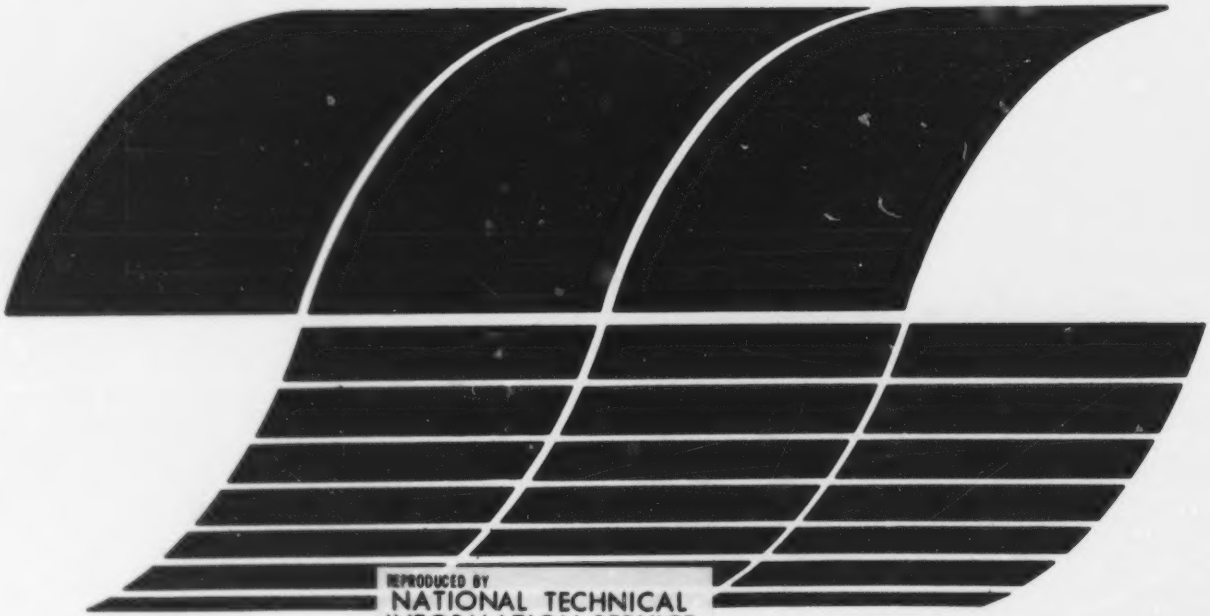

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16. ABSTRACT

The report discusses the test program and performance analysis of a single-cell mechanical-draft wet/dry cooling tower in Cliffside, NC. Objectives of the program were to obtain performance data and results on mass transfer, heat transfer, fluid flow, plume formation, and acoustic characteristics for comparison with models/theories. Correlations are presented for the wet-fill mass transfer coefficient, wet-fill water loss, Colburn j-factor for the finned tubes, and fan efficiency in terms of one or more of the following: water loading in the tubes, air loading over the fins, log mean humidity difference, outlet water temperature, Reynolds number, and airflow rate. Acoustic data were fitted to a series of curves for each of the eight octave bands. Attempts to model plume data failed. The report also describes the test facility, test procedures, instrumentation, data acquisition, and data reduction.

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Pollution	Fluid Flow	Pollution Control	13B	20D
Cooling Towers		Stationary Sources	13A, 07A, 13I	
Tests	Plumes		14B	21B
Analyzing	Acoustics			20A
Mass Transfer			14G	
Heat Transfer			20M	

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VOLUME II: APPENDICES

by

D. L. Ayers, M. R. Hogan, A. E. Hribar, R. A. Lucheta
Westinghouse Electric Corporation
Research & Development Center
1310 Buelah Road
Pittsburgh PA 15235

TVA Contract No. TV46267
TVA Project Director: Hollis B. Flora II

Tennessee Valley Authority
Division of Energy Demonstrations and Technology
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APPENDIX A

DESCRIPTION OF TOWER TEST FACILITY

A.1 INTRODUCTION

The cooling tower test facility is located at the Cliffside Generating Station of the Duke Power Company system in the Piedmont region of southwest North Carolina, on the northwest side of the main plant, adjacent to the Broad River. It consists of a single cell, mechanical draft, crossflow tower and associated water circulating, electrical, air control and instrumentation systems. The overall facility is shown in Figures A-1 and A-2.

Within the Cliffside station, the test tower is situated on a loop off the main hot water header connecting the high pressure condensor of Duke Power Co. unit 5 turbine to their cooling tower "A", in such a manner that a portion of the hot water enroute to their cooling tower system may be diverted through the test tower for test purposes and then discharged to the cold water basin of tower "A", as shown schematically in Figure A-3.

A.2 TOWER CONSTRUCTION

The cold water basin and sump at the bottom of the tower are constructed of poured-in-place reinforced concrete. The side wall structure is of precast, reinforced concrete, installed atop the cold water basin which also serves as the foundation, as shown in Figure A-4. The tower is fitted with a dry heat exchanger system on the two inlet faces of the cell. Each of the two sets of exchangers consists of four units 40 feet long by 10 feet wide, shown in Figure A-5. Each exchanger unit

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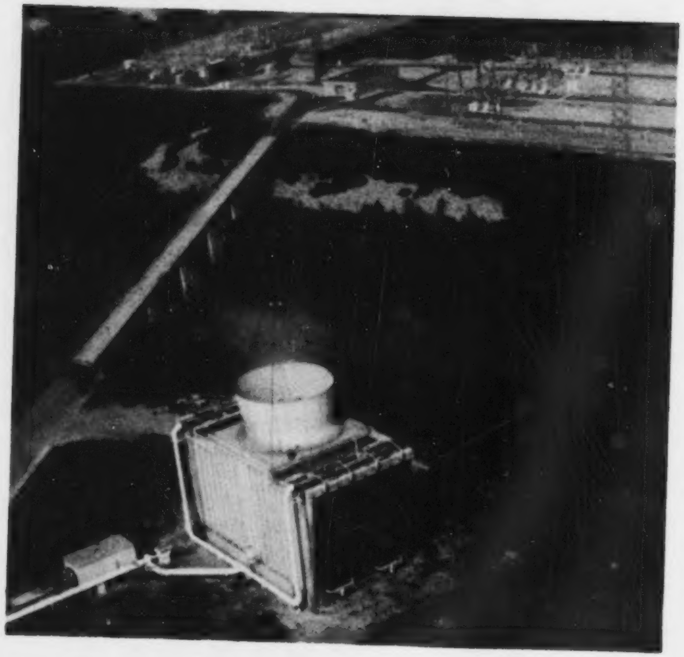

Figure A-1. Aerial View of the Cliffside Experimental Cooling Tower.

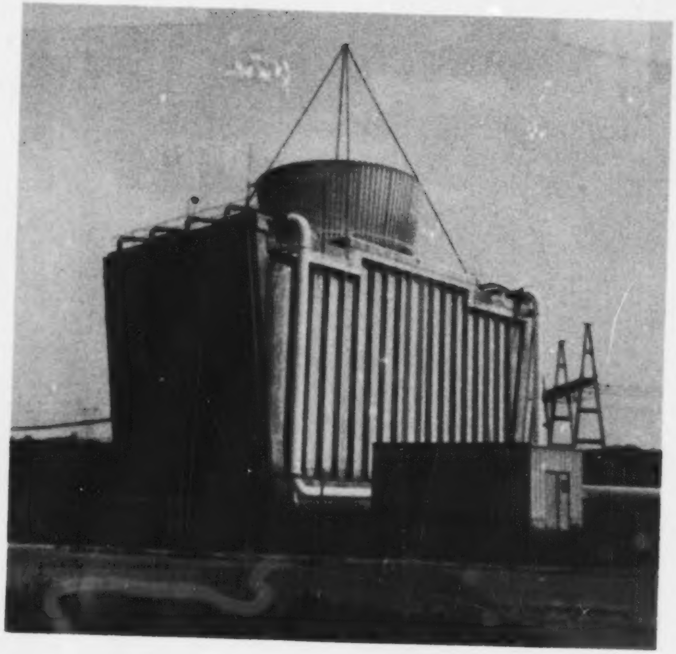

Figure A-2. Photograph of the Cliffside Tower Showing the Control House.

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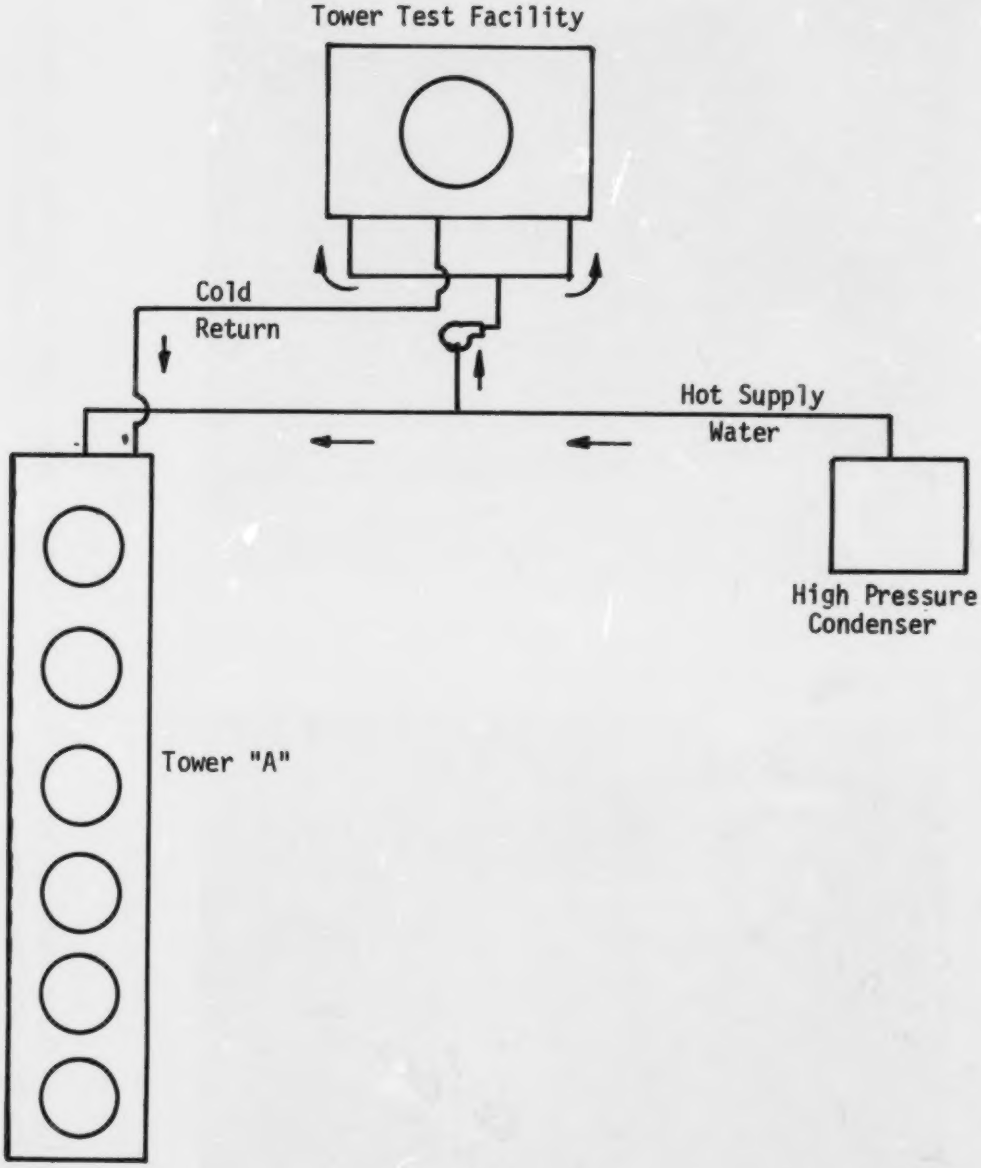
Tower Test Facility
Cold
Return
Hot Supply
Water
High Pressure
Condenser
Tower "A"

Figure A-3. Schematic of Hot Water Supply and Cold Water Return Systems for the Tower Test Facility.

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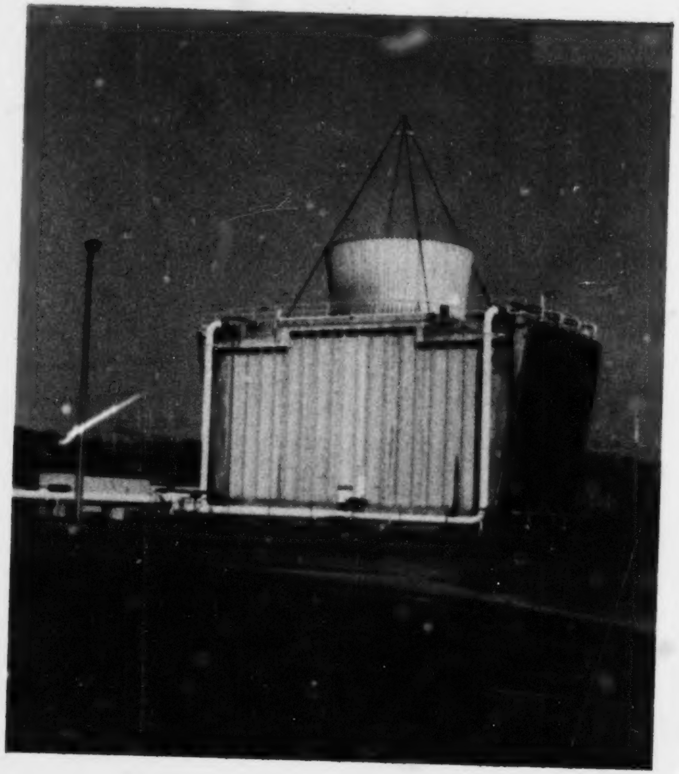

Figure A-4. View of Tower Showing Precast Side Wall Construction.

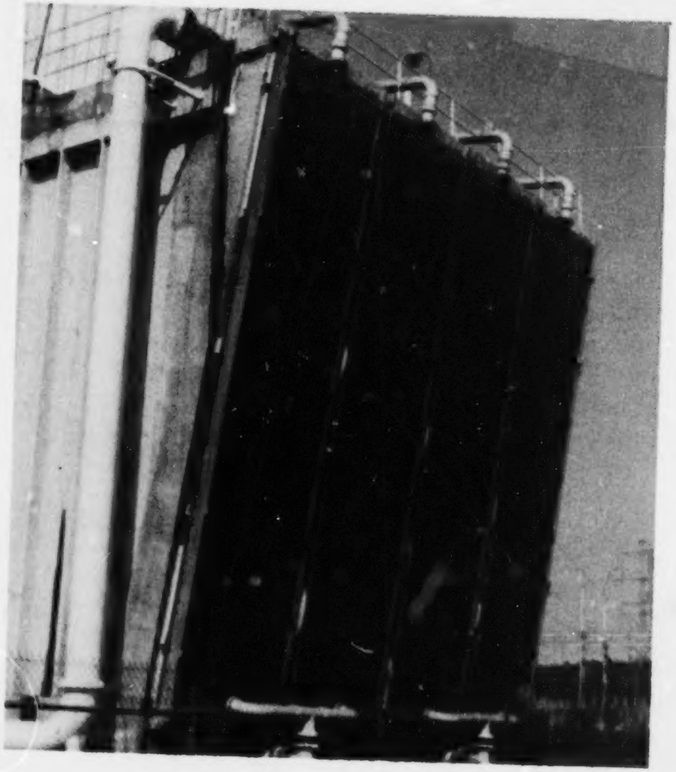

Figure A-5. View of Dry Heat Exchangers on the Tower Inlet Face.

contains 186 tubes of 90-10 Cu/Ni, 1.0 inches od with 0.035-inch-thick walls and finned with 0.018-inch-thick by 0.625-inch-high aluminum, wound on the tubes at 11 turns per inch. The tubes are rolled into their tube sheets on a 2.5-inch triangular pitch, with four tube rows. The inlet face area of the dry heat exchanger system is 3200 ft^2, 1600 ft^2 on each side of the tower. Located behind the dry heat exchangers are louvers which prevented water in the wet fill volume from spilling out of the front of the tower.

The fill volume, located behind the louvers, is 40 feet high by 18 feet deep by 40 feet wide, on each side of the cell. Fill elements are inverted V, perforated segments of fire-retardant PVC, supported by a grid of 0.10-inch-diameter, polyvinyl-coated, galvanized wire. The fill elements are installed with 8-inch vertical and 8-inch lateral pitches in an equally staggered array. Figure A-6 is a photograph of the fill elements in their wire spacer mesh. Figure A-7 shows the fill elements being installed. Located behind the fill volume are arc-shaped PVC drift eliminators, shown in Figure A-8. At the top of the tower, the two (one for each section of fill volume) hot water basins are of reinforced concrete situated on either side of the fan stack. The bottom of each basin contains 3.5-inch-diameter holes on 24-inch centers, in which PVC nozzles are installed to distribute hot water over the top of the fill, as shown in Figure A-9.

The fan deck is of reinforced concrete and is situated between the hot basins. It supports the 32-foot-diameter fiberglass fan stack and houses the fan. The fan deck and stack are shown in Figure A-10.

Figure A-11 shows one of the two 24-inch-diameter hot water distribution headers supported above the hot water basin. In the background is the Cliffside tower "A". Each header is equipped with two air-operated valves with which the flow into each basin is controlled. Each header also contains two manually operated valves used to isolate the dry heat exchangers when all-wet operation is desired. Each header is vented to atmosphere through a short stack, as shown in Figure A-11.

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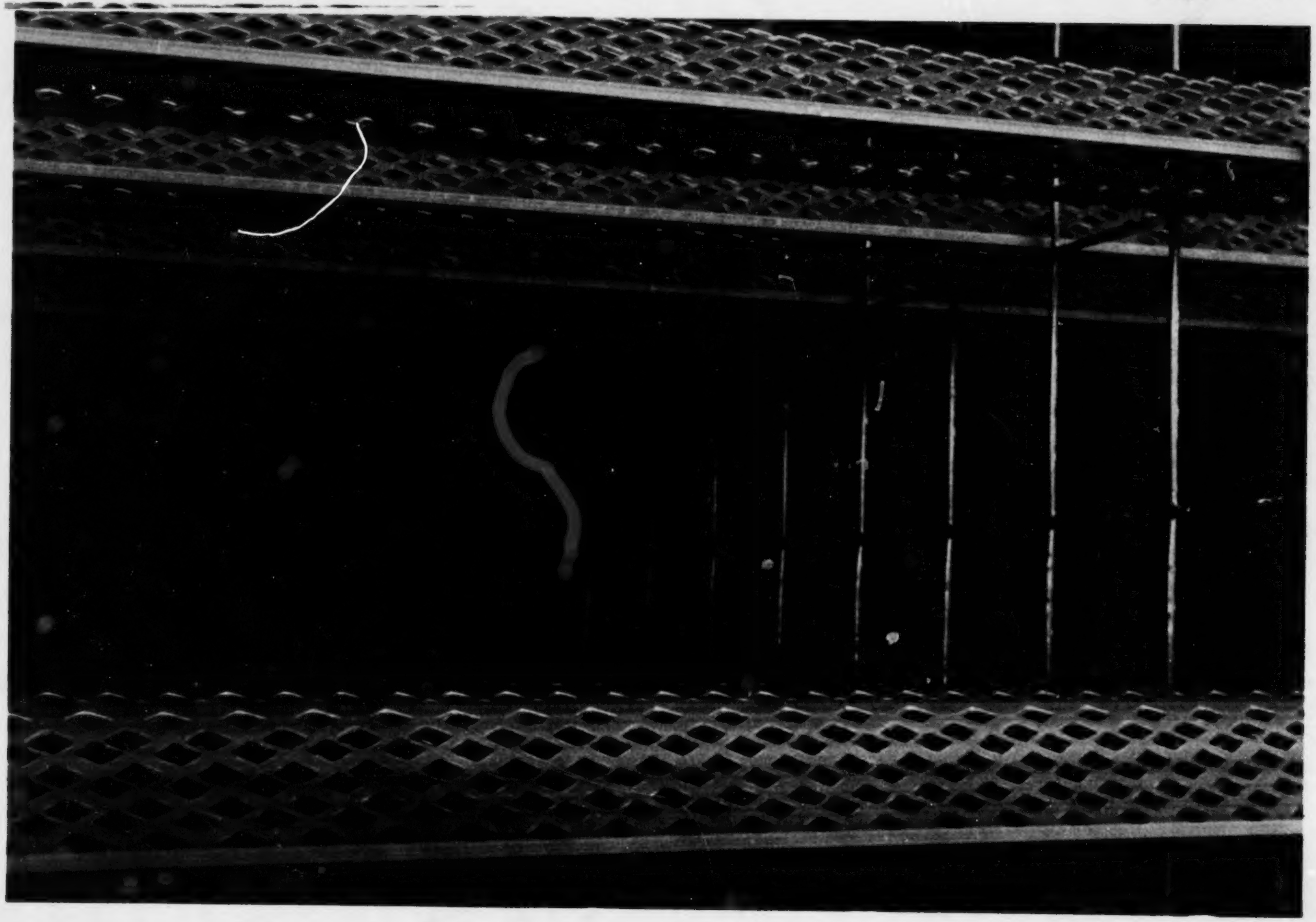

Figure A-6. Photograph of the Wet Fill Elements in Their Wire Mesh Spacer Grid.

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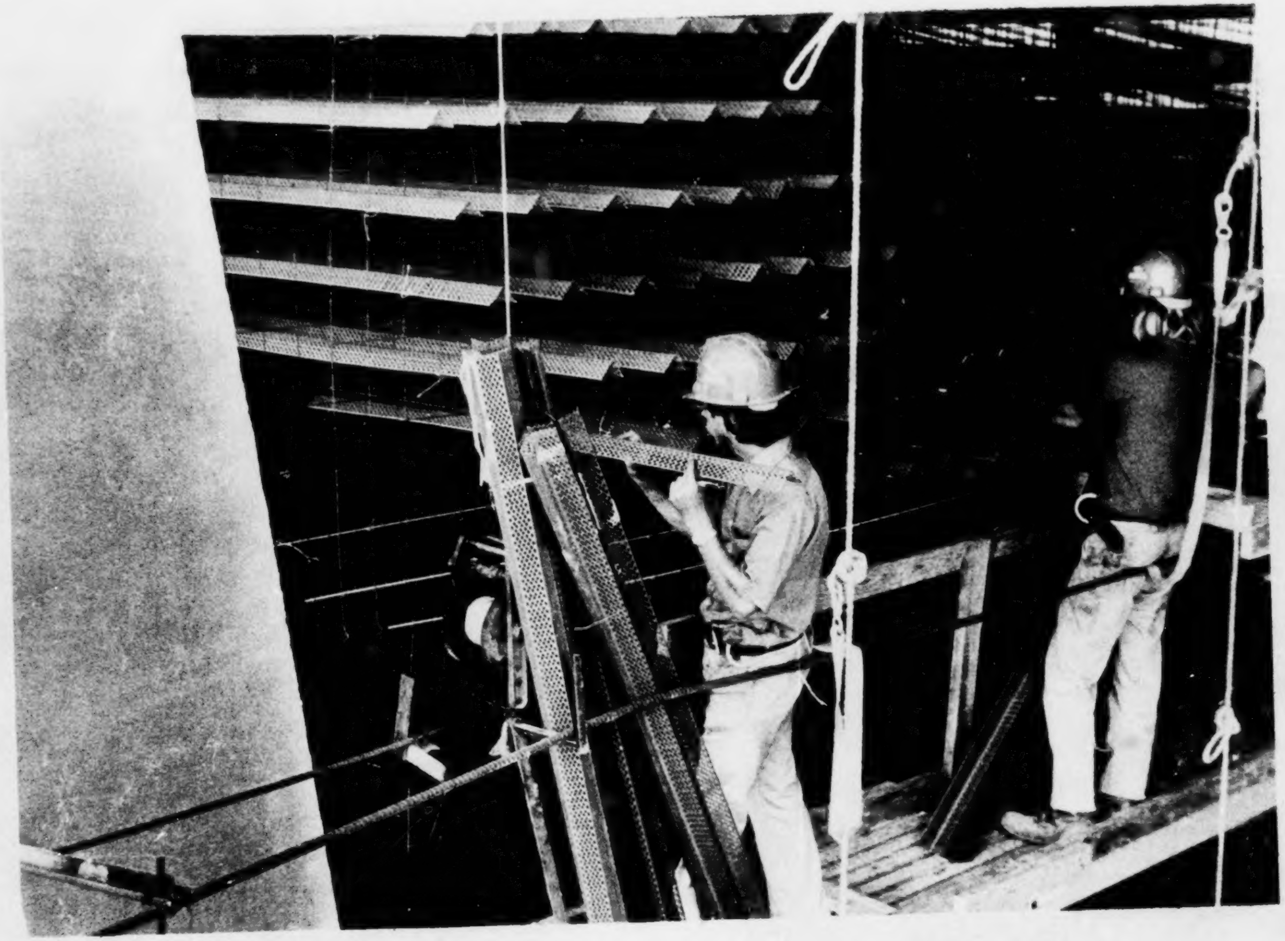

Figure A-7. View of Wet Fill Elements Being Installed.

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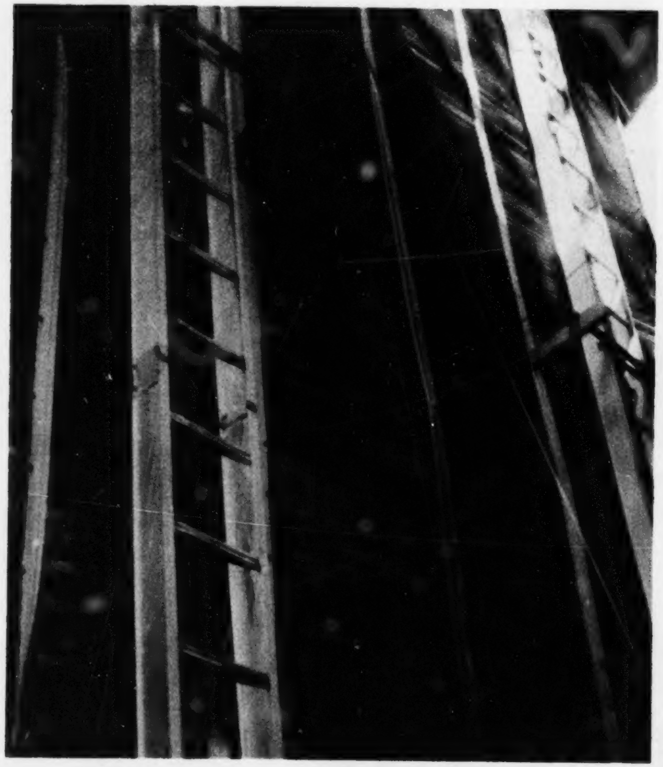

Figure A-8. View of the Rear of the Fill Section Showing the Drift Eliminator Assembly.

Figure A-9. Distribution Nozzles in the Hot Water Basin at the Top of the Tower.

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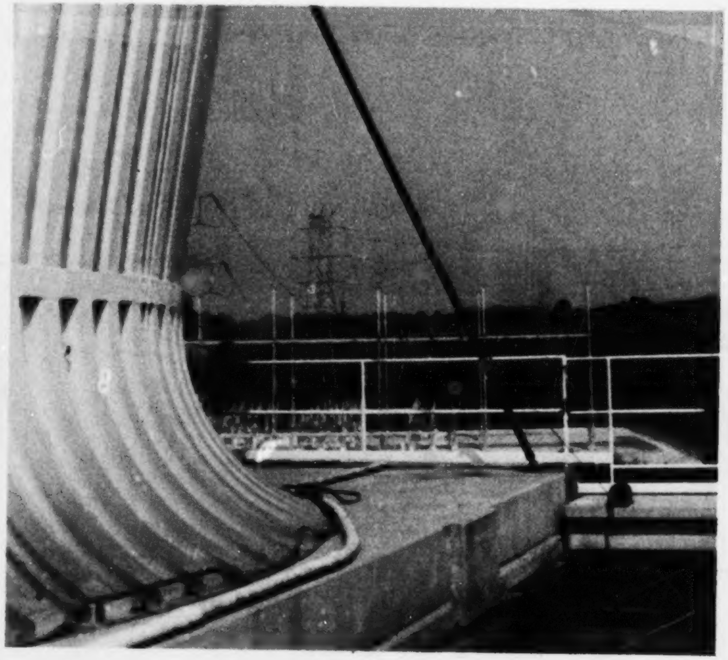

Figure A-10. Fan Deck and a Portion of the Fan Stack.

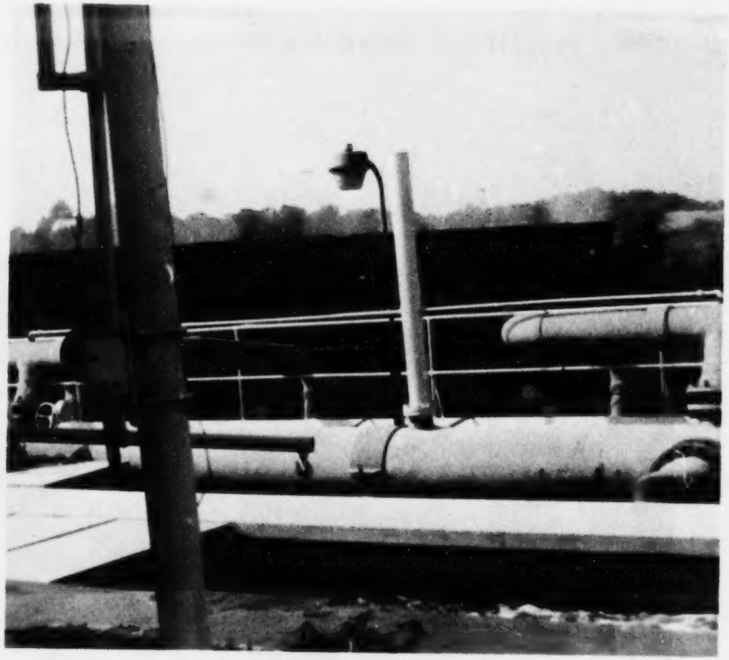

Figure A-11. View of the Hot Water Distribution Header at the Top of the Tower.

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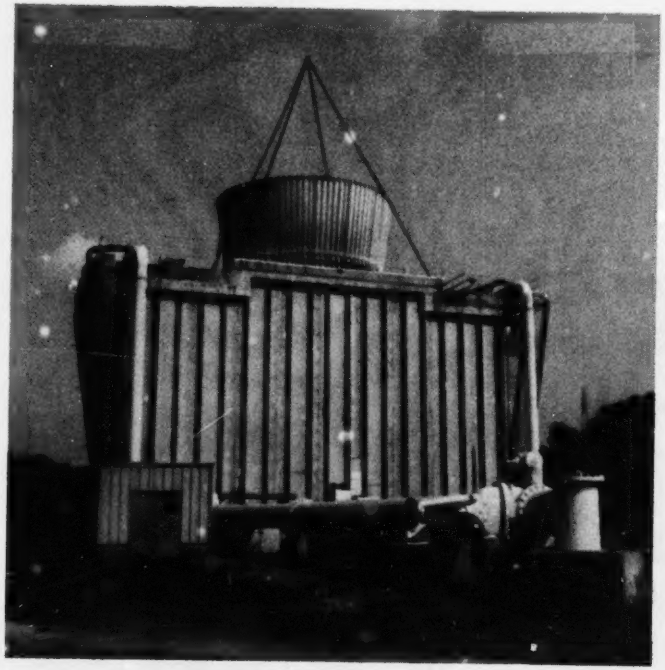

Figure A-12. Tower Hot Water Supply Piping.

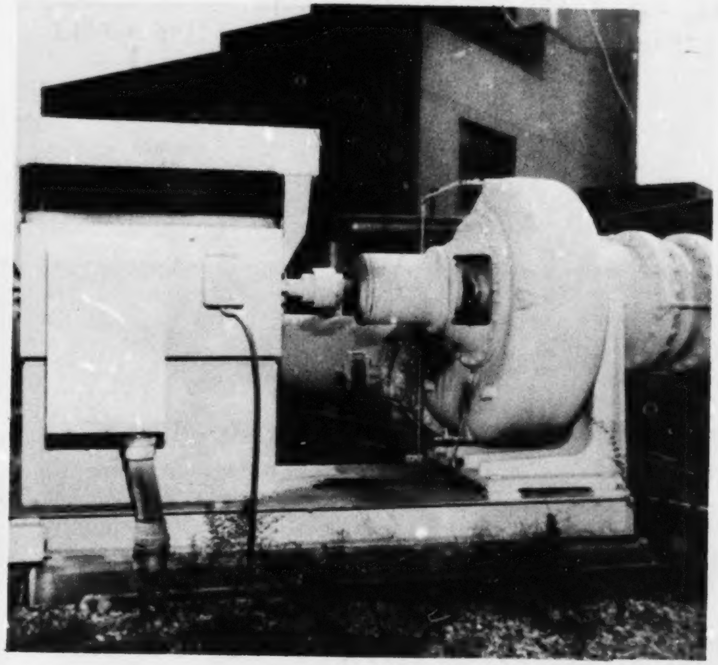

Figure A-13. Tower Hot Water Circulating Pump.

A.3 WATER SYSTEM

The hot water supply for the tower test facility is from the Cliffside plant's main hot water header, the connection being shown in Figure A-12. This figure shows a manually operated 24-inch-diameter gate valve used to isolate the test facility from the remainder of the plant. Hot water line size is stepped up to 36-inch diameter downstream from this valve and reduces again to 24-inch diameter at the hot water supply pump, shown in Figures A-13 and A-14. The 36-inch-diameter header is equipped with an Ellison Annubar flowmeter.

The pump is a 24-inch, type 24MN mixed flow pump powered by a 300 hp, 4160 VAC, 592 rpm motor. The pump is equipped with a vent and drain. A 24-inch air-operated control valve at the pump discharge controls the total flow of hot water to the tower. At the discharge of this valve the supply header is again stepped to 36-inch diameter as it runs to the base of the tower. Here the header tees into a horizontal 24-inch-diameter line which in turn elbows into two vertical risers, one for each side of the cell. The risers finally elbow into horizontal supply headers above each hot water basin at the top of the tower.

A.4 AIR SUPPLY

Air is drawn through each side of the tower cell by a Hudson Products Company 32-foot-diameter axial fan, model number T-32B-14, located in the fan stack at the top of the tower. This fan, shown in Figure A-15, is fitted with an epoxy-coated steel hub and 14 reinforced fiberglass blades whose pitch may be adjusted manually. The fan is powered through a 13.93:1 geared speed reducer by a 350 hp, 4160 VAC, 1800 rpm motor with wound rotor. Fan speeds of 64, 95, 101, 114, 120 and 127 rpm are available through motor controls. Figure A-16 shows the fan drive system.

Dwg. 7697A88

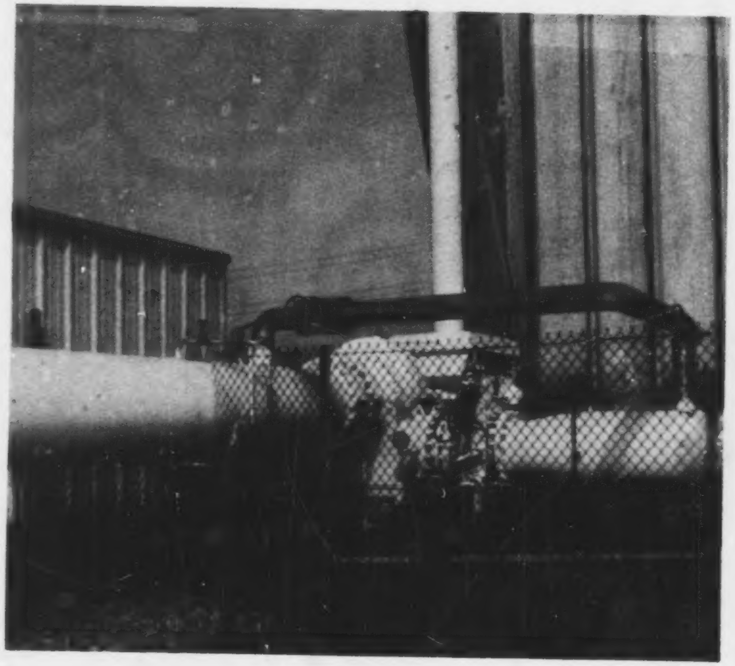

Figure A-14. Tower Hot Water Supply Pump with Bypass Line.

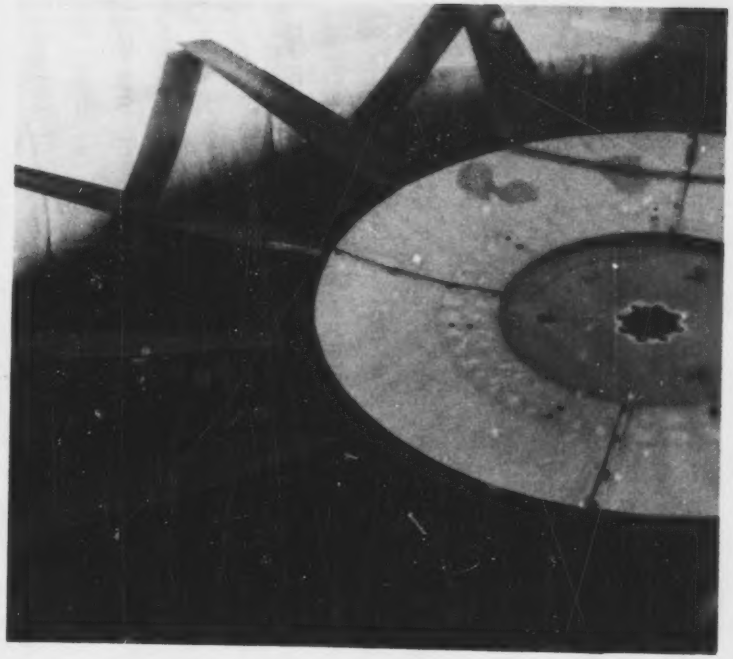

Figure A-15. Tower Air Circulating Fan.

A.5 CONTROLS

Controls for the tower test facility are located in a control house best seen in Figure A-2. Within this 12 feet by 24 feet structure is a Westinghouse power center, rated at 4160 VAC, which includes a main breaker, pump motor starter, fan motor starter and resistor bank, fan speed control switch and relays and some DC controls (Figure A-17). The resistor bank for the fan motor is fan cooled. Source of AC and DC power is the Duke plant.

Safety switches located in the water supply and discharge headers are interconnected with the pump motor controls, so that the pump cannot be operated, or will trip off, without sufficient supply water or high pressure on the discharge header. Control air monitoring switches prevent startup of the pump without sufficient control air pressure available. A float switch above the cold water sump trips off the pump motor if the water in the sump exceeds a predetermined level, to avoid flooding of the area in the event of line stoppage or incorrect valving on the discharge to the "A" tower basin. Vibration safety switches are located on the fan motor and speed reducer and an oil pressure safety switch monitors the speed reducer oil pressure.

Four air control stations are located in the control house. One station determines the amount of pressure from the control air supply from Duke's air system. The second station controls the position of the pump discharge valve opening and thus the amount of flow to the test tower. The remaining two control stations govern the air pressure to the two air-operated valves in the distribution headers above the hot water basins, thus controlling the flow into each hot water basin.

Dwg. 7697A89

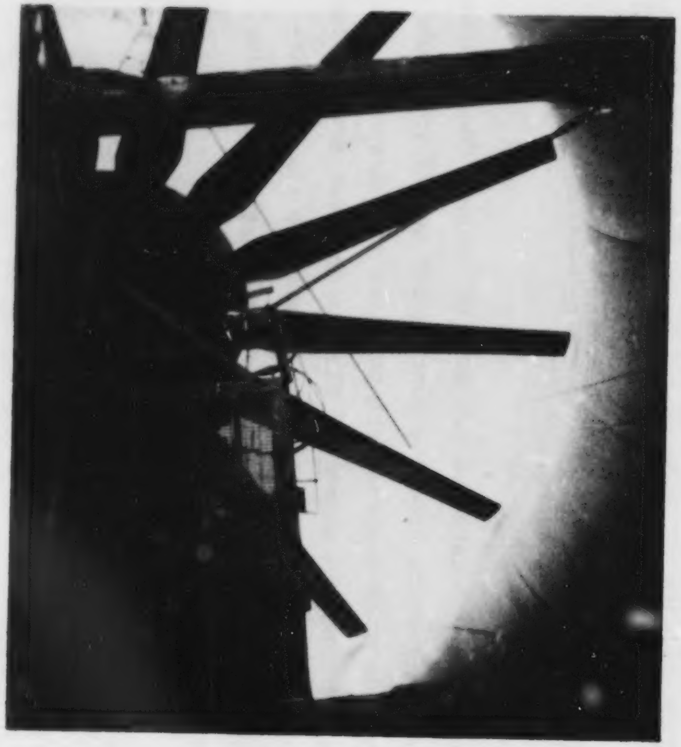

Figure A-16. View Into the Bottom of Fan Stack, Showing the Fan Drive Assembly.

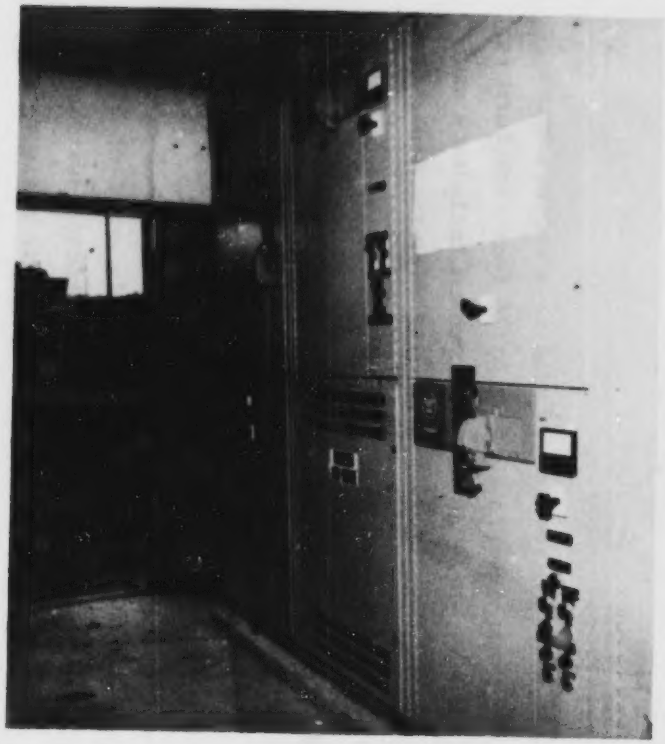

Figure A-17. Motor Controls for the Fan Drive System.

APPENDIX B

COOLING TOWER STARTUP, OPERATING AND SHUTDOWN PROCEDURES

This appendix covers the procedures followed by test site personnel in starting up, operating and shutting down the cooling tower test facility. It is included here in the event that future needs might require that the facility be run again as a test apparatus.

B.1 STARTUP PROCEDURE

I. Call Duke Power Company control room and get their operator's okay to start water fill.

II. Visually inspect inside tower to be secure and free of ice, also inlet louvers behind heat exchangers.

III. Check water system valving as follows:

1. 36-inch butterfly valve at Marley basin: OPEN
2. Pump discharge drain valve: CLOSE
3. Pump discharge vent valve: OPEN
4. Pump casing drain valve: CLOSE
5. Pump casing vent valve: OPEN
6. Pump suction drain valve: CLOSE
7. Pump suction vent valve: OPEN
8. 4-inch pump bypass valve: OPEN

IV. Check air control valving as follows:

1. Check air supply pressure, set to 24 psig.
2. Check and set pump discharge valve, manual control station pressure to 18 psig.
3. Check visually to see that pump discharge valve is fully closed.
4. Set east and west control valves to one-half open, by setting manual control valve pressures.

V. Check manual control valving as follows:

1. For 100 percent wet operation:
    a. The four 12-inch valves on top of tower - CLOSED
2. For 100 percent dry operation:
    a. The four 12-inch valves on top of tower - OPEN FULL
    b. The four 12-inch valves at bottom of heat exchanger - OPEN FULL
    c. Adjust bottom valves after flow is established through heat exchangers, to maintain heat exchanger full, as indicated by water being visible in tubing at top of heat exchanger.
3. For wet/dry operation, determine settings from proper wet/dry percentage sheets, after establishing desired total flow for tower.

VI. Set up remaining valving as follows:

1. Open 4-inch bypass valve around 24-inch supply valve.
2. Open 24-inch supply valve.
3. Close pump suction vent valve when air-free water flows.
4. Close pump casing vent valve.
5. Close pump discharge vent valve.
6. Close 4-inch bypass valve around pump.

Water system is now charged.

VII. Pump startup:

1. Set pump discharge valve control air to 16 psig.
2. Close the 120 V, DC control switch.
3. Check that green control circuit light on pump starter is ON.
4. Check that green control circuit light on fan starter is ON.
5. Depress PB-1 reset button on pump starter.
6. Check that green run light stays ON.
7. Check main breaker in ON position.
8. Check that approximately 4160 V, A-C are indicated on each phase, per voltmeter.
9. Remove padlock from pump starter lockout.
10. Place pump lockout in ON position.
11. Start pump by depressing START button.
12. Check that red light on panel comes ON.
13. Check that green start light goes OFF.
14. Open pump control valve by setting its manual control station pressure to 10 psig, no lower, to start flow through pump and stop cavitation.
15. Gradually adjust manual control station pressure to obtain the desired flow to the tower for the next test by monitoring the manometer.

16. Bleed the electronic flow meter and reset "zero" by opening flow meter manifold bypass valves, monitoring channel 119 on the Fluke and adjusting the "zero screw" at the flow meter as required, close bypass valves.
17. Make final, fine adjustment of pressure at manual control station to obtain desired flow, as indicated by average readout of channel 119 on the Fluke, and determined by the tower flow chart curve.
18. Measure water depth in each basin, top of tower and adjust "east-west" basin levels as required, by adjusting pressures at the "east-west" manual control stations.
19. The operator at top of tower will now make visual inspection of fan blades and hub to assure no ice, or foreign materials on rotating parts.

VIII. Fan Startup:

Caution: The fan is not to be started up unless it has been one hour minimum since it was shut down.

1. Start switchgear ventilator fan on high position.
2. Check that fan speed selector is in 50 percent position.
3. Double-check that green control circuit light is ON.
4. Check that VS-1 amber light is OFF.
5. Check that VS-2 amber light is OFF.
6. Remove padlock from fan starter lockout.
7. Place lockout in the ON position.
8. Press START button.
9. Check that red run light comes ON.
10. Check that green start light goes OFF.
11. Set fan to desired speed by stepping speed selector through speed ranges at one-minute intervals.

IX. Setting up Fluke data logger:

1. Energizing:
   - a. Check that power switch key is in the POWER ON position.
   - b. Check that the STOP/RESET button is depressed.
2. Date and time entry:
   - a. Check date and time by depressing DATE/TIME key on display control; if correct, check and enter day of year by depressing DAYS on time entry, indicating correct three-digit day on data entry keyboard; depressing ENTER/STEP.
   - b. Obtain the correct time by phone. Depress HR/MIN/SEC on time entry, indicate the correct military time using two digits for each hour, minute, second, depress ENTER/STEP.

3. Fixed data: Enter fixed data consisting of a five-digit test I.D. number from the test grid sheet and the single-digit run number denoting run number 1,2,3,4, or 5 of the given test, totaling six digits. This is done by depressing FIXED DATA on scan format, indicating the correct six-digit number on data entry keyboard and depressing ENTER/STEP.
4. Channel Selection:
    a. Depress FIRST CHANNEL on scan format; indicate desired channel on data entry keyboard and depress ENTER/STEP.
    b. Depress LAST CHANNEL on scan format; indicate desired channel on data entry keyboard and depress ENTER/STEP.
    c. A channel desired for monitoring is selected by depressing MONITOR CHANNEL on scan format, indicating the desired channel with data entry keyboard and depressing ENTER/STEP.
    d. Interval of time channel is to be monitored may be set by depressing INTERVAL/HR MIN SEC on scan format, indicating desired interval [two digits for each hr min sec (00.00.10 for 10 seconds)] on data entry keyboard and depressing ENTER/STEP.

X. Actuating the acoustical coupler:

1. Check that the switch on the terminal end is in the TEL position.
2. Turn switch on the opposite end ON; red light will glow.

XI. Actuating teletype:*

1. Turn switch to LINE position.
2. Depress tape ON button.
3. Run out about 2 feet of lead tape by depressing SHIFT, CONTROL, REPT., @ simultaneously.

B.2 SHUTDOWN PROCEDURE

I. Fan Shutdown:

1. Push STOP button.
2. Check red run light for OFF.
3. Check green light for ON.

---

*For taping test runs only. Other modes outlined later.

4. Place fan starter lockout in OFF position.
5. Replace padlock.
6. Turn 120 V, D-C control circuit OFF, only if pump is not running.
7. Allow ventilator fan to run for 5 minutes after main fan shutdown, then turn OFF.

II. Pump shutdown:

1. Depress STOP button.
2. Check that red run light goes OFF.
3. Check that green start light stays ON.
4. CLOSE 24-inch supply valve.
5. OPEN pump discharge drain valve.
6. OPEN pump discharge vent valve.
7. OPEN pump casing drain valve.
8. OPEN pump casing vent valve.
9. OPEN pump suction drain valve.
10. OPEN pump suction vent valve.
11. OPEN 4-inch pump bypass valve.
12. Move lockout on pump starter to OFF.
13. Replace padlock in lockout.
14. Place 120 V D-C control switch in OFF position, unless fan is running.

III. Securing site at end of each shift:

1. Check flow meter house door CLOSED.
2. CLOSE control house doors securely.
3. Check all fence gates CLOSED.
4. Check utility building door LOCKED.
5. Check acoustic coupler OFF.
6. Check teletype OFF.
*7. Check Fluke power ON.
*8. Check electronic manometer for ON.
*9. Check time base counter for ON.
*10. Check wattmeter for ON.

B.3 OPERATION PROCEDURE

I. First test of day only; electronic flow meter:
1. With tower in approximate desired mode of operation set up Fluke to monitor channel 119.
2. Zero the electronic flow meter. (One operator at the Fluke, one at the flow meter, each with walkie-talkie)

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*Except over off weekends or holidays, turn these instruments off.

a. OPEN equilizing valves on both flow meter manifolds.
b. Bleed air from both flow meter bodies.
c. With operator at Fluke monitoring values over walkie-talkie, operator at flow meter zeros the flow meter by turning the adjusting screw C.W. to increase, C.C.W. to decrease until zero is established by operator at Fluke.
d. With zero satisfied, CLOSE equalizing valves.
e. CLOSE and LATCH flow meter house door.

II. As part of each test; electronic manometer: with Scanivalves in 0-0 position as indicated by the panel lights, the electronic manometer dial set to the proper scale and sensor, the Fluke set to monitor channel 000, zero the electronic manometer, as follows: zero manometer as indicated on Fluke channel 000, using screwdriver in sensor adjusting screw, C.W. to increase, C.C.W. to decrease, on sensor no. 2.

III. Begin test by; Fluke, acoustic coupler and teletype:

1. Double-check date and time.
2. Double-check fixed data.
3. Enter 000 in first channel.
4. Enter 000 in last channel.
5. Set interval for 10 seconds.
6. Double-check acoustic coupler for proper switching.
7. Double-check teletype for line position.
8. Double-check teletype for tape on, lead on tape, date and test no. on tape lead.
9. Depress ALL DATA on the external enable panel.

IV. Make test run by; all stations:

1. Depress interval on Fluke scan control. Teletype will operate through 10 second cycle, then stop.
2. Immediately depress the pair of Scanivalve control buttons on control panel to advance Scanivalve indicating lights from 0-0 to 1-1.
3. Continue this sequence until the second set of 8-8 indicating lights are lit.
4. When teletype stops after recording data on second 8-8 position, depress STOP/RESET on Fluke.
5. Turn electronic manometer dial to ZERO.
6. Advance Scanivalve indicating lights to 8-8, then 0-0.
7. Depress FIRST CHANNEL on Fluke scan format.
8. Indicate channel 10 on data entry keyboard.
9. Depress ENTER/STEP.
10. Depress LAST CHANNEL on scan format.
11. Indicate channel 118 on data entry keyboard.

12. Depress ENTER/STEP.
13. Depress SINGLE on scan control. Teletype will operate and record data for channels 10 through 118 on paper and tape, then stop.
14. Check that monitor channel is 118, if not indicate on data entry keyboard.
15. Depress ENTER/STEP.
16. Depress MONITOR on scan control and allow teletype to record five lines of channel 118 data.
17. Depress STOP/RESET on Fluke.
18. Immediately depress MONITOR on scan format.
19. Indicate channel 119 on data entry keyboard.
20. Depress ENTER/STEP.
21. Depress MONITOR on scan control and allow teletype to record five lines of channel 119 data.
22. Depress STOP/RESET button on Fluke.

V. Manual monitored data; test trailer and control house. Meanwhile a second operator records manually-monitored data:

1. In control house, hand record for channels 120 through 130 as per data form.
2. In control yard, hand record for channels 131 through 133.
3. In test trailer, hand record for channels 134 through 137.
4. When step IV-22 above is completed, one operator manually types the data on the teletype, indicating the channel number, space, data, double-space; channel number, space, data, double-space, etc.

   Note: When an error is made, count the number of spaces involved in the error, then depress the percent key one time for each space counted, then type in the data correctly. On all entries consisting only of full unit values, end the figures with a decimal point as: (100.).
5. With manual data typed in complete, type CR,LF.

   This completes data logging for one standard run. Each test will consist of five runs, except plume tests, which consist of three runs.

6. Initiate next run or next test.

APPENDIX C

DATA REDUCTION PROGRAM

The purpose of this appendix is to present the data reduction program which reads the paper tape from the cooling tower data acquisition system, decodes and converts the information to pressure, temperature, flow rate, etc. and then calculates the tower mass transfer coefficient, air-side heat transfer coefficient, fan efficiency, etc. Table C-1 presents a sample input listing for nonplume tests.

It is evident from the table that the data exists in several formats. The initial data, columnar in format, is the velocity pressure valve output and is recorded automatically by machine during a scan. Channels 10-114 (the first two or three digit number in an entry) are fill, air, and dewcell temperatures. Multiple readings of channel 118, the dry heat exchanger pressure transducer, insured a good average measurement. The same argument applies to the Annubar pressure transducer output, channel 119. Channels 120-137 were the only manual entries.

If the test was to acquire plume data, then additional information would follow channel 137. Table C-2 presents a concise decoding of the information on each data tape by channel. Table C-3 should be referred to for information regarding the first data entries.

The data reduction program listing is presented in Table C-4. With the numerous comment cards and Section 4.3 the reader should be able to follow the program and its logic. It is pertinent to note that the program is organized in a hierarchy of subroutines, each one having a very specific function. As a result, the main program is little more

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than a series of call statements and the necessary logic for routing the data to the appropriate subprograms.

Table C-5 is a listing of the output from a WET/DRY run. Most of the output should be self-explanatory with only a few exceptions. Output which is presented as an array (e.g., Tower Inlet Air States) is arranged so that the spatial orientation between the printed output and the tower location is maintained. Consider, for instance, the 'Tower Inlet Air States' array. Reading from left to right corresponds to scanning the tower from left to right, with respect to an observer moving with the air stream. Reading from top to bottom of a column of array elements corresponds to scanning the tower from top to bottom. In addition, the tower inlet, wet fill inlet, and wet fill outlet arrays also correspond spatially, i.e., left to right in any of the three arrays corresponds to the same movement in the tower.

The tower inlet velocity array is set to zero in the read subroutine (to avoid undefined variables in the common block) since the probes are never used. The space was provided, however, in the event that they were ever utilized.

Under the 'Wet Tower Heat and Mass Transfer Results' is a value titled 'Percent Difference Between Stack and Tower Face Velocity'. This was intended to be a check between the air flow rate as calculated by the stack and heat exchanger face velocity pressure probes. Since the face probes remained unused, the percent difference is 100.0 Under the same wet tower results section there is a 'Percent Difference in Flow Rate as Perceived by the Manometer and Transducer' heading which, in this case, indicates a 100.0 percent value. This simply means that either the Annubar manometer, or the pressure transducer reading was not available for that test. The program automatically uses whichever is available and sets the difference to 100 percent.

Under 'Dry Tower Heat Transfer Results' is another heading of 'Percent Difference in Flow Rate as Perceived by the Manometer and Transducer'. The large reading indicates that either the dry heat exchanger manometer or pressure transducer reading was not available for that test (in this case it was the transducer).

TABLE C-1

SAMPLE INPUT LISTING FOR NONPLUME TESTS

```
151:08:54:36
  421242
  0 + 0.000 V
151:08:54:46
  421242
  0 + 1.427 V
151:08:54:56
  421242
  0 + 1.370 V
151:08:55:06
  421242
  0 + 5.248 V
151:08:55:16
  421242
  0 + 1.558 V
151:08:55:26
  421242
  0 + 1.139 V
151:08:55:36
  421242
  0 + 1.276 V
151:08:55:46
  421242
  0 + 1.428 V
151:08:55:56
  421242
  0 + 1.441 V
151:08:56:06
  421242
  0 + 1.589 V
151:08:56:16
  421242
  0 + 1.028 V
151:08:56:38
  421242
 10 +  83.9 F   11 + 140.9 F   12 + 138.4 F   13 + 136.6 F
 14 +  68.9 F   15 +  68.5 F   16 + 142.0 F   17 + 141.4 F
 18 + 101.2 F   19 + 140.1 F   20 + 141.2 F   21 + 139.5 F
 22   BT    F   23 + 141.4 F   24 + 141.0 F   25 +  68.9 F
 26 +  68.8 F   27 +  69.0 F   28 +  68.9 F   29 +  68.6 F
```

(Continued)

Table C-1 (cont'd)

```
 30 +  68.8 F    31 +  68.9 F    32 +  69.0 F    33 +  67.5 F
 34 +  67.0 F    35 + 192.1 F    36 + 178.7 F    37 + 185.1 F
 38 + 150.1 F    39 + 176.4 F    40 + 184.9 F    41 + 193.1 F
 42 + 190.1 F    43 + 184.8 F    44 + 179.8 F    45 +  91.2 F
 46 +  80.9 F    47 +  96.5 F    48 +  99.7 F    49 + 100.5 F
 50 +  85.6 F    51 +  98.4 F    52 +  98.0 F    53 + 100.4 F
 54 +  97.8 F    55 +  99.9 F    56 + 100.3 F    57 +  86.6 F
 58 +  70.0 F    59 +  70.7 F    60 +  98.6 F    61 +  83.2 F
 62 +  89.7 F    63 +  95.4 F    64 +  96.1 F    65 +  81.3 F
 66 +  85.0 F    67 +  91.8 F    68 +  93.2 F    69 +  95.2 F
 70 +  99.2 F    71 +  99.6 F    72 +  85.3 F    73 +  89.7 F
 74 +  92.1 F    75 +  77.5 F    76 +  91.1 F    77 +  98.4 F
 78 +  93.3 F    79 +  88.5 F    80 + 100.0 F    81 +  99.3 F
 82 +  97.1 F    83 +  92.9 F    84 +  99.5 F    85 +  98.5 F
 86 +  94.8 F    87 + 101.3 F    88 + 189.0 F    89 + 176.8 F
 90 + 172.3 F    91 + 178.6 F    92   BT     F    93 + 193.5 F
 94 +  90.5 F    95 +  90.9 F    96 +  89.4 F    97 +  96.1 F
 98 +  98.4 F    99 +  65.7 F   100 +  67.0 F   101 +  67.4 F
102 +  67.0 F   103 +  67.1 F   104 +  67.0 F   105 +  67.3 F
106 + 136.1 F   107 + 138.6 F   108 +  94.2 F   109 +  98.5 F
110 + 142.5 F   111 + 139.1 F   112 +  72.4 F   113 +  72.1 F
114 +  68.9 F   115 +  68.8 F   116 +  72.6 F   117   BT     F
118 -  0.05MV
151:08:59:42
  421242
118 -  0.06MV  118 -  0.05MV  118 -  0.06MV  118 -  0.05MV
118 -  0.06MV  118 -  0.06MV  118 -  0.06MV  118 -  0.05MV
118 -  0.05MV  118 -  0.06MV  118 -  0.06MV  118 -  0.05MV
118 -  0.05MV  118 -  0.06MV  118 -  0.06MV  118 -  0.06MV
118 -  0.05MV  118 -  0.05MV  118 -  0.05MV  118 -  0.05MV

151:09:04:28
  421243
119 + 81.29MV  119 + 80.35MV  119 + 81.17MV  119 + 83.26MV
119 + 84.07MV  119 + 84.01MV  119 + 83.70MV  119 + 83.41MV
119 + 83.50MV  119 + 81.74MV  119 + 83.50MV  119 + 84.09MV
119 + 85.91MV  119 + 84.39MV  119 + 81.34MV  119 + 76.73MV
119 + 83.44MV  119 + 83.46MV  119 + 81.99MV  119 + 79.87MV
120 4050.  121 45.5  122 45 .5  123 45 .5  124 35.5  125 35.5
126 35.0  127 12.8  128 10.0  129 70.0  130 2.95  131 00.0
132 00.0  133 00.0  134 127.  135 12.  136 .200  137 30.09
151:09:05:58
```

TABLE C-2

DELINEATION OF INPUT PAPER TAPE DATA BY CHANNEL

Channel	Description
0	11 repetitions of time, run ID, and transducer output (refer to Table C-4). The first grouping contains the transducer's zero, Group 2 and 3 are velocity pressures, 4 is a static pressure, and the remaining are velocity pressures.
10	Tower basin cold water return temperature
11-13	Heat exchanger air inlet dewcell temperature
14-15	Heat exchanger inlet air temperature
16-17	Heat exchanger inlet air dewcell temperature
18	Tower hot water inlet temperature
19-21	Heat exchanger inlet air dewcell temperature
22	Not used
23-24	Heat exchanger inlet air dewcell temperature
25-32	Heat exchanger inlet air temperature
33-34	Heat exchanger outlet water temperature
35-44	Wet fill outlet air dewcell temperature
45-57	Fill water temperature
58-59	Ambient air temperature
60-76	Fill water temperature
77-86	Wet fill outlet air temperature
88	Not used

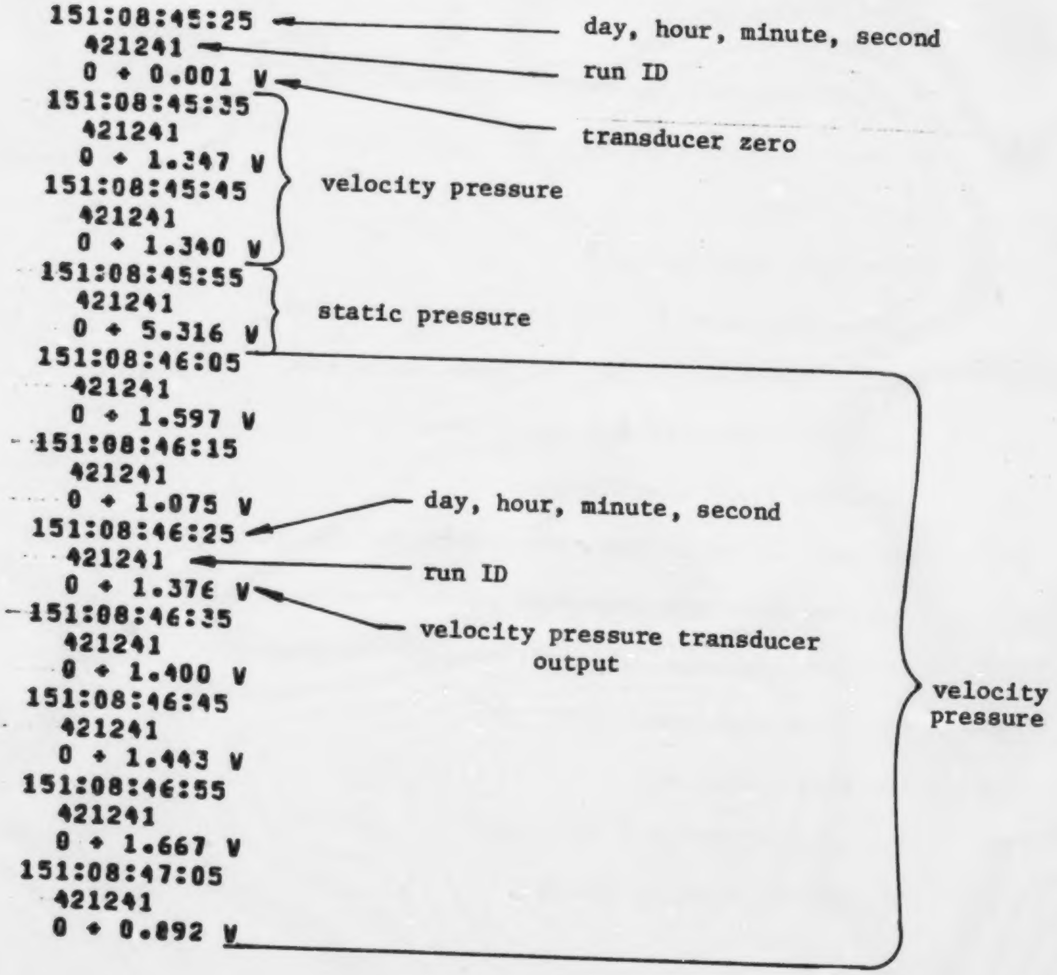
(Continued)

Table C-2 (cont'd)

Channel	Description
89-93	Stack exit air dewcell temperature
94-98	Stack exit air temperature
99-105	Fill inlet air temperature
106-107	Ambient air dewcell temperature
108-109	Fill water temperature
110-117	Not used
118	Dry heat exchanger pressure drop transducer
119	Annubar element transducer
120	Tower voltage (v)
122-126	Tower pump amperage (a)
127	Annubar manometer column rise above datum (in)
128	Annubar manometer column fall below datum (in)
129	Annubar manometer ambient temperature (°F)
130	Manometer fluid specific gravity
131	Dry heat exchanger manometer column fall below datum (in)
132	Dry heat exchanger manometer column rise above datum (in)
133	Dry heat exchanger manometer temperature (°F)
134	Fan rotational speed (RPM)
135	Fan pitch (degrees)
136	Fan power (reading x 700 - kw)
137	Barometric pressure (in Hg)

TABLE C-3

TOWER DIFFUSER THROAT STATIC AND VELOCITY PRESSURE DATA



```
151:08:45:25
 421241
 0 + 0.001 V
151:08:45:35
 421241
 0 + 1.347 V
151:08:45:45
 421241
 0 + 1.340 V
151:08:45:55
 421241
 0 + 5.316 V
151:08:46:05
 421241
 0 + 1.597 V
151:08:46:15
 421241
 0 + 1.075 V
151:08:46:25
 421241
 0 + 1.376 V
151:08:46:35
 421241
 0 + 1.400 V
151:08:46:45
 421241
 0 + 1.443 V
151:08:46:55
 421241
 0 + 1.667 V
151:08:47:05
 421241
 0 + 0.892 V
```

day, hour, minute, second
run ID
transducer zero
velocity pressure
static pressure
day, hour, minute, second
run ID
velocity pressure transducer output
velocity pressure

TABLE C–4

LISTING OF TOWER DATA REDUCTION COMPUTER CODE

```
      PROGRAM TVATOW (INPUT,OUTPUT,PUNCH,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7=
     1PUNCH)
      DIMENSION IELEV(8,5), DBP(8,5), WBDP(8,5), AVELP(8,5), NCT2(5)
      DIMENSION VISIO(5)
      DIMENSION A(11), B(5), TOLTWO(2), AHTX(21), BHTX(5), TOLWB(2)
      DIMENSION TOLTOW(2), IPUNCH(7,5), AFAN(5)
      COMMON /DATIN/ TIDP(10),TIAT(10),WTL1(12),WTL2(4),WTL3(12),WTL4(4)
     1,TODP(10),TOAT(10),SEDP(5),SET(5),ADPT(2),AT(2),XOWT(2),DBT,CWRT,H
     2WIT,FIDBT(7),VHTX,PERFF,TV,PA(3),FA(3),HI,XLOW,AMB,SPGR,XLOWDR,HID
     3RY,AMBDRY,RPM,FANANG,FANPWR,BARO,VPHTX(9),CAL1,VPSTK(10),CAL2,ICOD
     4E(6),IDATE
      COMMON /DAT2/ IELEV,DBP,WBDP,AVELP,VISIO,NCT2
      DATA AHTX/1.0,.93,2.25,1.072,2.5,.018,11.0,4.0,184.0,.72167,40.1,2
     16.0,118.0,5667.25,7*0.0/
      DATA IPUNCH/1,1,2,1,1,1,1,3,2,3,3,2,2,3,6,3,6,6,3,3,6,6,6,6,6,4,5,
     16,6,6,6,6,6,6,6/
      DATA AFAN/16.0,.7924,36.4167,32.0,.34/
      DATA SHEIG/63.5/
      IPUN=1
C
C     IF AIR MASS FLOWRATE IS TO BE DETERMINED BY A WATER ENERGY
C     BALANCE, THEN SET IMASS=1, IF NOT THEN IMASS=0
C
      IMASS=0
C
C     SET ALL PHYSICAL CONSTANTS
C     FAN DIAMETER (FT)
```

(Continued)

Table C-4 (cont'd)

```
                                                                   AC  280
      FBDIA=32.0                                                   AC  290
C                                                                  AC  300
C     EFFECTIVE FILL HEIGHT (FT) FOR AIR LOADING CALCULATION       AC  310
C                                                                  AC  320
      HIGHG=39.5                                                   AC  330
C                                                                  AC  340
C     EFFECTIVE FILL WIDTH(FT) FOR AIR LOADING CALCULATION         AC  350
C                                                                  AC  360
      WIDTHG=41.167                                                AC  370
C                                                                  AC  380
C     EFFECTIVE FILL DEPTH (FT) FOR WATER LOADING CALCULATION      AC  390
C                                                                  AC  400
      DEPL=10.0                                                    AC  410
C                                                                  AC  420
C     INTEGRATION HEIGHT(FT)                                       AC  430
C                                                                  AC  440
      XIHIGH=39.667                                                AC  450
C                                                                  AC  460
C     INTEGRATION DEPTH(FT)                                        AC  470
C                                                                  AC  480
      XIDEP=10.0                                                   AC  490
C                                                                  AC  500
C     ABSOLUTE (DEG.F) AND RELATIVE ERROR DESIRED IN CALCULATION OF  AC  510
C     A MULTIPLIER USED TO DETERMINE THE NUMBER OF VERTICAL TOWER  AC  520
C     INCREMENTS                                                   AC  530
C                                                                  AC  540
      XMFY=1.0                                                     AC  550
          PROGRAM TVATOW(INPUT,OUTPUT,PUNCH,TAPE5=INPUT,TAPE6=OUTPUT,

C                                                                  AC  560
C     TOWER EXIT WATER TEMPERATURE                                 AC  570
C                                                                  AC  580
      TOLTOW(1)=.01                                                AC  590
      TOLTOW(2)=.0001                                              AC  600
```

(Continued)

Table C-4 (cont'd)

```
C                                                                         AC   610
C     NUMBER OF STACK VELOCITY PRESSURE MEASUREMENTS                      AC   620
C                                                                         AC   630
      NSTKO=10                                                            AC   640
C                                                                         AC   650
C     NUMBER OF HEAT EXCHANGER FACE VELOCITY PRESSURE                     AC   660
C     MEASUREMENTS                                                        AC   670
C                                                                         AC   680
      NHTX=9                                                              AC   690
C                                                                         AC   700
C     FACE AREA OF HEAT EXCHANGER (FT**2)                                 AC   710
C                                                                         AC   720
      HTXARA=1726.11                                                      AC   730
C                                                                         AC   740
C     STACK CROSS-SECTIONAL AREA AT LOCATION OF VELOCITY PRESSURE PROBES  AC   750
C                                                                         AC   760
      ASTACK=1003.825                                                     AC   770
C                                                                         AC   780
C     SET ANY PROGRAM CONTROL CONSTANTS                                   AC   790
C     IS STACK STATIC PRESSURE AVAILABLE? YES=1                           AC   800
C                                                                         AC   810
      ISTATP=1                                                            AC   820
C                                                                         AC   830
C     IF IT IS AVAILABLE WHAT IS ITS LOCATION IN VPSTK(N)?                AC   840
C                                                                         AC   850
      NSTATP=3                                                            AC   860
C                                                                         AC   870
C     WILL STATIC PRESSURE AND FAN CURVE BE USED TO CALCULATE AIR         AC   880
C     FLOWRATE?  YES=1, NO=0                                              AC   890
C                                                                         AC   900
      IFAN=0                                                              AC   910
C                                                                         AC   920
C     TRANSDUCER OR MANOMETER FOR TOWER WATER FLOWRATE?                   AC   930
C     ITRANI=0--MANOMETER                                                 AC   940
C     ITRANI=1--TRANSDUCER                                                AC   950
C                                                                         AC   960
```

(Continued)

Table C-4 (cont'd)

```
      ITRANI=0                                                          AC  970
C                                                                       AC  980
C     TRANSDUCER OR MANOMETER FOR DRY TOWER WATER FLOWRATE?             AC  990
C     ITRAND=0--MANOMETER                                               AC 1000
C     ITRAND=1 --TRANSDUCER                                             AC 1010
C                                                                       AC 1020
      ITRAND=0                                                          AC 1030
C                                                                       AC 1040
C     VZERO=TRANSDUCER OUTPUT AT ZERO PRESSURE DIFFERENCE               AC 1050
C                                                                       AC 1060
      VZERO=.0008                                                       AC 1070
C                                                                       AC 1080
C     WETBULB TEMERATURE CONVERGENCE TOLERANCES (DEG.F, ND)             AC 1090
C                                                                       AC 1100
      TOLWB(1)=.01                                                      AC 1110
      TOLWB(2)=.0001                                                    AC 1120
C                                                                       AC 1130
C     CONVERSION FOR FANPOWER AS GIVEN ON TAPE TO FT-LBF/SEC            AC 1140
C                                                                       AC 1150
      FANCON=700.0*7.376E+2                                             AC 1160
      PI=3.141592654                                                    AC 1170
      INX=1                                                             AC 1180
  109 CALL REDUC (INX,IFLAG,IPUN)                                       AC 1190
      CALL CODE (ICODE,IDATE,IPUN)                                      AC 1200
C                                                                       AC 1210
C     SET ANY OTHER CONSTANTS                                           AC 1220
C                                                                       AC 1230
      BARPSI=BARO*4.912E-1                                              AC 1240
      NSTK=NSTKO                                                        AC 1250
      ITRAN=ITRANI                                                      AC 1260
C                                                                       AC 1270
C     CONVERT DEWCELL TEMPERATURES TO DEWPOINT                          AC 1280
C                                                                       AC 1290
      CALL DEWCON (TIDP,10)                                             AC 1300
      CALL DEWCON (TODP.10)                                             AC 1310
```

(Continued)

Table C-4 (cont'd)

```
      CALL DEWCON (ADPT,2)
      CALL DEWCON (SEDP,5)
      WRITE (6,329) (AT(I),ADPT(I),I=1,2),BARO
      WRITE (6,339) (TIAT(I),TIDP(I),I=1,10)
      WRITE (6,349) (FIDBT(7),I=1,7)
      WRITE (6,359) (TOAT(I),TODP(I),I=1,10)
      WRITE (6,369) (SET(I),SEDP(I),I=1,5)
      WRITE (6,379) HWIT,DBT,(XOWT(I),I=1,2),CWRT
      WRITE (6,389) (WTL1(I),I=1,12)
      WRITE (6,399) (WTL2(I),I=1,4)
      WRITE (6,409) (WTL3(I),I=1,12)
      WRITE (6,419) (WTL4(I),I=1,4)
C
C     CALCULATE WATER FLOW RATE FOR TOWER CELL
C
      GPMWAT=ANUBAR(PERFF,HI,XLOW,SPGR,AMB,HWIT,PERDIF,ITRANI)
C
C     NOTE THAT PERDIF IS THE PERCENT DIFFERENCE IN FLOW RATE AS A
C     RESULT OF MEASURING THE ANUBAR OUTPUT WITH TWO PRESSURE DIFFERENCE
C     DEVICES.  GPMWAT IS CALCULATED USING THE MANOMETER
C     CALCULATE WATER PROPERTIES NEAR ANUBAR
C
      CALL WATPRO (HWIT,XMUW,XKW,CPW,PRW,RHOW)
C
C     CALCULATE WATER FLOW RATE (LBM/HR)
C
      WATFLO=60.0*GPMWAT*RHOW/7.48
      MM=ICODE(1)
      GO TO (119,129,139,119,129,129,119), MM
  119 CONTINUE
C
C     TOWER OPERATION IS ALL WET
C
      DRYFLO=0.0
```

(Continued)

Table C-4 (cont'd)

```
                                                                         AC 1660
      GPMDRY=DRYFLO                                                      AC 1670
      GPMWET=GPMWAT                                                      AC 1680
      WETFLO=WATFLO                                                      AC 1690
      GO TO 149                                                          AC 1700
  129 CONTINUE                                                           AC 1710
C                                                                        AC 1720
C     TOWER OPERATION IS WET AND DRY                                     AC 1730
C     CALCULATE WATER PROPERTIES AT DISTRIBUTION BASIN TEMPERATURE       AC 1740
C                                                                        AC 1750
      CALL WATPRO (DBT,XMUW,XKW,CPW,PRW,RHOW2)                           AC 1760
      CALL WATPRO (HWIT,G,G,G,G,RHODRY)                                  AC 1770
      IF (VHTX.GT.500.0) VHTX=1.0E-10                                    AC 1780
      GPMDRY=WATDIST(HIDRY,XLOWDR,SPGR,AMBDRY,AHTX(11),HWIT,ITRAND,VHTX/ AC 1790
     11000.0,VZERO,PERDRY)                                               AC 1800
      DRYFLO=GPMDRY*RHODRY*60.0/7.48                                     AC 1810
      WETFLO=WATFLO-DRYFLO                                               AC 1820
      GPMWET=WETFLO*7.48/(60.0*RHOW2)                                    AC 1830
      GO TO 149                                                          AC 1840
  139 CONTINUE                                                           AC 1850
C                                                                        AC 1860
C     TOWER OPERATION IS ALL DRY                                         AC 1870
C                                                                        AC 1880
      WETFLO=0.0                                                         AC 1890
      GPMWET=WETFLO                                                      AC 1900
      GPMDRY=GPMWAT                                                      AC 1910
      DRYFLO=WATFLO                                                      AC 1920
  149 CONTINUE                                                           AC 1930
C                                                                        AC 1940
C     CALCULATE AVERAGE TOWER STATE PROPERTIES                           AC 1950
C     AVERAGE TOWER INLET DEWPOINT                                       AC 1960
C                                                                        AC 1970
      AVTIDP=AVG(TIDP,10)                                                AC 1980
C                                                                        AC 1990
C     AVERAGE TOWER INLET DRY BULB                                       AC 2000
C
```

(Continued)

Table C-4 (cont'd)

```
      AVTIAT=AVG(TIAT,10)                                        AC 2010
C                                                                AC 2020
C     AVERAGE TOWER INLET SPECIFIC HUMIDITY                      AC 2030
C                                                                AC 2040
      AVTIW=SATHUM(AVTIDP,BARPSI)                                AC 2050
C                                                                AC 2060
C     AVERAGE TOWER INLET SPECIFIC ENTHALPY                      AC 2070
C                                                                AC 2080
      AVTIH=AIRH(AVTIW,BARPSI,AVTIAT)                            AC 2090
C                                                                AC 2100
C     AVERAGE TOWER INLET WET BULB TEMPERATURE                   AC 2110
C                                                                AC 2120
      AVTIWB=TWB(AVTIAT,BARPSI,AVTIW,TOLWB)                      AC 2130
C                                                                AC 2140
C     AVERAGE TOWEROUTLET DEWPOINT                               AC 2150
C                                                                AC 2160
      AVTODP=AVG(TODP,10)                                        AC 2170
C                                                                AC 2180
C     AVERAGE TOWER OUTLET TEMPERATURE                           AC 2190
C                                                                AC 2200
      AVTOAT=AVG(TOAT,10)                                        AC 2210
C                                                                AC 2220
C     AVERAGE TOWER OUTLET SPECIFIC HUMIDITY                     AC 2230
C                                                                AC 2240
      AVTOW=SATHUM(AVTODP,BARPSI)                                AC 2250
C                                                                AC 2260
C     AVERAGE TOWER OUTLET SPECIFIC ENTHALPY                     AC 2270
C                                                                AC 2280
      AVTOH=AIRH(AVTOW,BARPSI,AVTOAT)                            AC 2290
C                                                                AC 2300
C     AVERAGE TOWER OUTLET WET BULB TEMPERATURE                  AC 2310
C                                                                AC 2320
      ATOWB=TWB(AVTOAT,BARPSI,AVTOW,TOLWB)                       AC 2330
C                                                                AC 2340
C     AVERAGE STACK DEWPOINT                                     AC 2350
```

(Continued)

Table C-4 (cont'd)

```
C                                                                       AC 2360
      AVSEDP=AVG(SEDP,5)                                                AC 2370
C                                                                       AC 2380
C     AVERAGE STACK TEMPERATURE                                         AC 2390
C                                                                       AC 2400
      AVSET=AVG(SET,5)                                                  AC 2410
C                                                                       AC 2420
C     AVERAGE STACK SPECIFIC HUMIDITY                                   AC 2430
C                                                                       AC 2440
      AVSEW=SATHUM(AVSEDP,BARPSI)                                       AC 2450
C                                                                       AC 2460
C     AVERAGE STACK SPECIFIC ENTHALPY                                   AC 2470
C                                                                       AC 2480
      AVSEH=AIRH(AVSEW,BARPSI,AVSET)                                    AC 2490
C                                                                       AC 2500
C     AVERAGE STACK WET BULB TEMPERATURE                                AC 2510
C                                                                       AC 2520
      AVSEWB=TWB(AVSET,BARPSI,AVSEW,TOLWB)                              AC 2530
C                                                                       AC 2540
C     AVERAGE STACK RELATIVE HUMIDITY(PERCENT)                          AC 2550
C                                                                       AC 2560
      SERH=RELHUM(AVSEW,BARPSI,AVSET)                                   AC 2570
      IF (SERH.GT.100.0) SERH=100.0                                     AC 2580
C                                                                       AC 2590
C     AVERAGE FILL INLET TEMPERATURE                                    AC 2600
C                                                                       AC 2610
      AVFIDBT=AVG(FIDBT,7)                                              AC 2620
C                                                                       AC 2630
C     AVERAGE FILL INLET SPECIFIC ENTHALPY                              AC 2640
C                                                                       AC 2650
      AVFIH=AIRH(AVTIW,BARPSI,AVFIDBT)                                  AC 2660
C                                                                       AC 2670
C     AVERAGE FILL INLET WETBULB TEMPERATURE                            AC 2680
C                                                                       AC 2690
      AVFIWB=TWB(AVFIDBT,BARPSI,AVTIW,TOLWB)                            AC 2700
```

(Continued)

Table C-4 (cont'd)

```
C                                                                       AC 2710
C     AVERAGE FILL INLET SPECIFIC HUMIDITY                              AC 2720
C                                                                       AC 2730
      AVFIW=AVTIW                                                       AC 2740
C                                                                       AC 2750
C     AVERAGE AMBIENT DEWPOINT                                          AC 2760
C                                                                       AC 2770
      AVADPT=AVG(ADPT,2)                                                AC 2780
C                                                                       AC 2790
C     AVERAGE AMBIENT TEMPERATURE                                       AC 2800
C                                                                       AC 2810
      AVAT=AVG(AT,2)                                                    AC 2820
C                                                                       AC 2830
C     AVERAGE AMBIENT SPECIFIC HUMIDITY                                 AC 2840
C                                                                       AC 2850
      AVAW=SATHUM(AVADPT,BARPSI)                                        AC 2860
C                                                                       AC 2870
C     AVERAGE AMBIENT SPECIFIC ENTHALPY                                 AC 2880
C                                                                       AC 2890
      AVAH=AIRH(AVAW,BARPSI,AVAT)                                       AC 2900
C                                                                       AC 2910
C     AVERAGE AMBIENT WET BULB TEMPERATURE                              AC 2920
C                                                                       AC 2930
      AVAWB=TWB(AVAT,BARPSI,AVAW,TOLWB)                                 AC 2940
C                                                                       AC 2950
C     AVERAGE HEAT EXCHANGER WATER OUTLET TEMPERATURE                   AC 2960
C                                                                       AC 2970
      AVXOWT=AVG(XOWT,2)                                                AC 2980
C                                                                       AC 2990
C     FILL AVERAGE OUTLET WATER TEMPERATURE                             AC 3000
C                                                                       AC 3010
      FAVOWT=AVG(WTL4,4)                                                AC 3020
C                                                                       AC 3030
C     FILL-LEVEL I AVERAGE WATER TEMPERATURE                            AC 3040
```

(Continued)

Table C-4 (cont'd)

```
C                                                                      AC 3050
      FLIWT=AVG(WTL1,12)                                               AC 3060
C                                                                      AC 3070
C     CALCULATE VELOCITIES FROM VELOCITY PRESSURE                      AC 3080
C     REARRANGE THE STACK VELOCITY PRESSURE ARRAY SINCE ONE OF ITS     AC 3090
C     MEMBERS IS ACTUALLY A STATIC PRESSURE AND CONVERT TO INCHES      AC 3100
C     OF WATER                                                         AC 3110
C                                                                      AC 3120
      J=1                                                              AC 3130
      IEND=NSTK                                                        AC 3140
      SSP=0.0                                                          AC 3150
      DO 159 I=1,IEND                                                  AC 3160
         ARG=VPSTK(I)+CAL2                                             AC 3170
         VPSTK(I)=CONVERT(ARG,2)                                       AC 3180
         VPSTK(J)=VPSTK(I)                                             AC 3190
         IF (I.NE.NSTATP.OR.ISTATP.NE.1) GO TO 159                     AC 3200
         SSP=VPSTK(I)                                                  AC 3210
         J=J-1                                                         AC 3220
         NSTK=NSTK-1                                                   AC 3230
  159 J=J+1                                                            AC 3240
C                                                                      AC 3250
C     CONVERT THE TOWER FACE VELOCITY PRESSURE MEASUREMENTS TO INCHES  AC 3260
C     OF WATER PRESSURE                                                AC 3270
C                                                                      AC 3280
      DO 169 I=1,NHTX                                                  AC 3290
         ARG=VPHTX(I)+CAL1                                             AC 3300
  169 VPHTX(I)=CONVERT(ARG,1)                                          AC 3310
C                                                                      AC 3320
C     CALCULATE STACK AND TOWER FACE VELOCITIES                        AC 3330
C                                                                      AC 3340
      CALL VEL (VPSTK,NSTK,AVSEDP,BARPSI,AVSET)                        AC 3350
      CALL VEL (VPHTX,NHTX,AVTIW,BARPSI,AVTIAT)                        AC 3360
C                                                                      AC 3370
C     CALCULATE TOWER DRY AIR MASS FLOWRATE FROM THE STACK VELOCITY    AC 3380
```

(Continued)

Table C-4 (cont'd)

```
C     PROFILE                                                           AC 3390
C     AND COMPARE TO THAT OBTAINED WITH TOWER FACE VELOCITIES.  NOTE    AC 3400
C     THAT AIRER IS THE PERCENT DIFFERENCE THE MASS FLOWRATE AS         AC 3410
C     CALCULATED BY THE TOWER FACE VELOCITIES DIFFERS FROM THAT         AC 3420
C     CALCULATED BY THE STACK MEASUREMENTS.                             AC 3430
C                                                                       AC 3440
      WRITE (6,429) (VPHTX(I),I=1,NHTX)                                 AC 3450
      WRITE (6,439) (VPSTK(I),I=1,NSTK)                                 AC 3460
      WRITE (6,449) SSP                                                 AC 3470
      WRITE (6,459) AVFIDBT,AVFIWB,AVTIDP,AVFIW,AVFIH                   AC 3480
      WRITE (6,469) AVTOAT,ATOWB,AVTODP,AVTOW,AVTOH                     AC 3490
      TMF=TOFLO(VPSTK,NSTK,ASTACK,VPHTX,NHTX,HTXARA,AVSET,BARPSI,AVTIAT,AC 3500
     1AIRER)                                                            AC 3510
C                                                                       AC 3520
C     CALCULATE CELL DRY AIR MASS FLOW RATE                             AC 3530
C                                                                       AC 3540
      CMF=TMF/2.0                                                       AC 3550
      IF (IMASS.NE.1) GO TO 179                                         AC 3560
C                                                                       AC 3570
C     LOGIC ENTERS THIS PASTH IF AIR MASS FLOWRATE IS TO BE             AC 3580
C     DETERMINED BY A WATER ENERGY BALANCE                              AC 3590
C                                                                       AC 3600
      CALL WATPRO (FAVOWT,GARB,GARB,CPWTO,GARB,BARB)                    AC 3610
      CALL WATPRO (DBT,GARB,GARB,CPWTI,GARB,GARB)                       AC 3620
      CMF=WETFLO*(CPWTI*DBT-CPWTO*FAVOWT)/(AVTOH-AVFIH)                 AC 3630
      TMF=CMF*2.0                                                       AC 3640
  179 CONTINUE                                                          AC 3650
C                                                                       AC 3660
C     CALCULATE MASS AVERAGE STACK EXIT AIR VELOCITY(FT/SEC) FOR PLUME  AC 3670
C     DATA OUTPUT                                                       AC 3680
C                                                                       AC 3690
      SEV=4.0*TMF*(1.0+AVSEW)/(3600.0*RHOAIR(AVSEEW,AVSET,BARPSI)*PI*AFAAC 3700
     1N(3)**2)                                                          AC 3710
C                                                                       AC 3720
```

(Continued)

Table C-4 (cont'd)

```
C     CALCULATE AIR VOLUME FLOWRATE(CFS) FOR PLUME DATA OUTPUT           AC 3730
C                                                                        AC 3740
      AVF=SEV*PI*AFAN(3)**2/4.0                                          AC 3750
C                                                                        AC 3760
C     CALCULATE AIR FLOWRATE FROM FAN CURVE                              AC 3770
C                                                                        AC 3780
      QGUESS=(DRYFLO*(HWIT-(XOWT(1)+XOWT(2))/2.0)+WETFLO*(DBT-FAVOWT))/( AC 3790
     1(AVTOH-AVTIH)*60.0*RHOAIR(AVSEW,AVSET,BARPSI))                     AC 3800
      QFAN=AFFFC(AFAN,FANANG,RPM,BARPSI,AVSET,AVSEW,SSP,QGUESS)          AC 3810
C                                                                        AC 3820
C     CHECK TO SEE IF AIR FLOWRATE FROM FAN CURVE WILL                   AC 3830
C     BE USED RATHER THAN VELOCITY TRAVERSE                              AC 3840
C                                                                        AC 3850
      IF (IFAN.NE.1) GO TO 189                                           AC 3860
      TMF=QFAN*60.0*RHOAIR(AVSEW,AVSET,BARSPI)/(1.0+AVSEW)               AC 3870
      CMF=TMF/2.0                                                        AC 3880
  189 CONTINUE                                                           AC 3890
      IF (ICODE(1).EQ.3) GO TO 199                                       AC 3900
C                                                                        AC 3910
C     AIR LOADING                                                        AC 3920
C                                                                        AC 3930
      G=CMF/(HIGHG*WIDTHG)                                               AC 3940
C                                                                        AC 3950
C     WATER LOADING                                                      AC 3960
C                                                                        AC 3970
      XL=WETFLO/(WIDTHG*DEPL)                                            AC 3980
      NY=IFIX(XMFY*(XIHIGH-30.0)*(1188.0*XL**.599*G**.438/DBT**2.04)*(AI AC 3990
     1RH(SATHUM(DBT,BARPSI),BARPSI,DBT)-AIRH(AVFIW,BARPSI,AVFIDBT))/(XL* AC 4000
     2(DBT-FL1WT)))                                                      AC 4010
      NX=IFIX((DBT-FL1WT)*XL*XIDEP*FLOAT(NY)/((AVTOH-AVFIH)*G*(XIHIGH-30 AC 4020
     1.0)))                                                              AC 4030
      WRITE (6,489) DBT,FAVOWT,WETFLO,GPMWET,PERDIF,XL,CMF,G,AIRER,NY,NX AC 4040
     1,HIGHG,WIDTHG,DEPL                                                 AC 4050
      IF (ICODE(1).EQ.3) GO TO 199                                       AC 4060
```

(Continued)

Table C-4 (cont'd)

```
      A(1)=DBT                                                          AC 4070
      A(2)=AVFIH                                                        AC 4080
      A(3)=AVFIDBT                                                      AC 4090
      A(4)=NX                                                           AC 4100
      A(5)=NY                                                           AC 4110
      A(6)=G                                                            AC 4120
      A(7)=XL                                                           AC 4130
      A(8)=XIDEP                                                        AC 4140
      A(9)=XIHIGH                                                       AC 4150
      A(10)=BARPSI                                                      AC 4160
      A(11)=FAVOWT                                                      AC 4170
C                                                                       AC 4180
C     CALCULATE TOWER NTU AND OUTLET AIR STATES                         AC 4190
C                                                                       AC 4200
      XNTU=TOWNTU(A,B,TOLTOW)                                           AC 4210
C                                                                       AC 4220
C     CALCULATED AVERAGE TOWER OUTLET AIR TEMPERATURE                   AC 4230
C                                                                       AC 4240
      CTOAT=B(1)                                                        AC 4250
C                                                                       AC 4260
C     CALCULATED TOWER OUTLET AIR WET BULB TEMPERATURE                  AC 4270
C                                                                       AC 4280
      CTOWB=B(2)                                                        AC 4290
C                                                                       AC 4300
C     CALCULATED TOWER OUTLET AIR SPECIFIC ENTHALPY                     AC 4310
C                                                                       AC 4320
      CTOH=B(3)                                                         AC 4330
C                                                                       AC 4340
C     CALCULATED TOWER MASS TRANSFER COEFFICIENT                        AC 4350
C                                                                       AC 4360
      XKA=B(4)                                                          AC 4370
C                                                                       AC 4380
C     CALCULATED TOWER OUTLET AIR SPECIFIC HUMIDITY                     AC 4390
C                                                                       AC 4400
```

(Continued)

Table C-4 (cont'd)

```
      CTOW=B(5)                                                         AC 4410
C                                                                       AC 4420
C     CALCULATE WATER LOSS BY EVAPORATION                               AC 4430
C                                                                       AC 4440
      WATLOS=CMF*(AVTOW-AVTIW)                                          AC 4450
C                                                                       AC 4460
C     CALCULATE WATER LOSS THROUGH THE TOWER                            AC 4470
C                                                                       AC 4480
      STLOS=CMF*(AVSEW-AVTIW)                                           AC 4490
C                                                                       AC 4500
C     CALCULATE FILL WATER LOSS AS A PERCENT OF DRY AIR FLOWRATE        AC 4510
C                                                                       AC 4520
      WLOSDA=(AVTOW-AVTIW)*100.0                                        AC 4530
C                                                                       AC 4540
C     CALCULATE FILL WATER LOSS AS A PERCENT OF WATER FLOWRATE          AC 4550
C                                                                       AC 4560
      WLWF=WATLOS*100.0/WETFLO                                          AC 4570
C                                                                       AC 4580
C     CALCULATE DEWPOINT                                                AC 4590
C                                                                       AC 4600
      CTODP=TSATV(CTOW*BARPSI/(.62198+CTOW))                            AC 4610
      WRITE (6,479) CTOAT,CTOWB,CTODP,CTOW,CTOH                         AC 4620
C                                                                       AC 4630
C     WET ENERGY EXCHANGE BASED ON AIR STATES                           AC 4640
C                                                                       AC 4650
      WEEAS=CMF*(AVTOH-AVFIH)                                           AC 4660
C                                                                       AC 4670
C     CALCULATED WET ENERGY EXCHANGE BASED ON AIR STATES                AC 4680
C                                                                       AC 4690
      CWEEAS=CMF*(CTOH-AVFIH)                                           AC 4700
C                                                                       AC 4710
C     DIFFERENCE IN MEASURED AND CALCULATED AIR ENERGY EXCHANGE         AC 4720
C                                                                       AC 4730
      DAEE=((WEEAS-CWEEAS)/WEEAS)*100.0                                 AC 4740
```

(Continued)

Table C-4 (cont'd)

```
C                                                                       AC 4750
C     ENERGY EXCHANGE BASED ON WATER STATES                             AC 4760
C                                                                       AC 4770
      EEWS=WETFLO*(HF(DBT)-HF(FAVOWT))                                  AC 4780
C                                                                       AC 4790
C     WET ENERGY CONSERVATION ERROR IN PERCENT                          AC 4800
C                                                                       AC 4810
      WECE=(WEEAS-EEWS)*100.0/EEWS                                      AC 4820
      WRITE (6,499) XKA,XNTU,WATLOS                                     AC 4830
      WRITE (6,509) STLOS,WLOSDA,WLWF                                   AC 4840
      WRITE (6,519) WEEAS,DAEE,EEWS,WECE                                AC 4850
  199 CONTINUE                                                          AC 4860
      IF (ICODE(1).EQ.1.OR.ICODE(1).EQ.4.OR.ICODE(1).EQ.7) GO TO 209    AC 4870
      IF (GPMDRY.LT.1000.0) GO TO 209                                   AC 4880
C                                                                       AC 4890
C     SET UP ARRAYS FOR DRY TOWER CALCULATIONS                          AC 4900
C                                                                       AC 4910
      AHTX(15)=CMF*(1.0+AVSEW)                                          AC 4920
      AHTX(16)=DRYFLO                                                   AC 4930
      AHTX(17)=AVTIAT                                                   AC 4940
      AHTX(18)=AVFIDBT                                                  AC 4950
      AHTX(19)=HWIT                                                     AC 4960
      AHTX(20)=AVXOWT                                                   AC 4970
      AHTX(21)=BARPSI                                                   AC 4980
C                                                                       AC 4990
C     PERFORM DRY TOWER CALCULATIONS                                    AC 5000
C                                                                       AC 5010
      CALL HTX (AHTX,BHTX)                                              AC 5020
C                                                                       AC 5030
C     CALCULATE HEAT EXCHANGER ENERGY EXCHANGE BASED ON AIR STATE       AC 5040
C                                                                       AC 5050
      HTXEE=CMF*(AVFIH-AVTIH)                                           AC 5060
C                                                                       AC 5070
C     CALCULATE ENERGY EXCHANGE BASED ON WATER STATE                    AC 5080
```

(Continued)

Table C-4 (cont'd)

```
C                                                                       AC 5090
      HTXEW=DRYFLO*(HWIT-AVXOWT)                                        AC 5100
      EHTX=((HTXEE-HTXEW)/HTXEW)*100.0                                  AC 5110
C                                                                       AC 5120
C     AIRSIDE FILM COEFFICIENT                                          AC 5130
C                                                                       AC 5140
      HA=BHTX(1)                                                        AC 5150
C                                                                       AC 5160
C     AIRSIDE REYNOLDS NUMBER                                           AC 5170
C                                                                       AC 5180
      RE=BHTX(2)                                                        AC 5190
C                                                                       AC 5200
C     AIR SIDE STANTON NUMBER                                           AC 5210
C                                                                       AC 5220
      ST=BHTX(3)                                                        AC 5230
C                                                                       AC 5240
C     J FACTOR                                                          AC 5250
C                                                                       AC 5260
      XJ=BHTX(4)                                                        AC 5270
C                                                                       AC 5280
C     AIRSIDE NUSSELT NUMBER                                            AC 5290
C                                                                       AC 5300
      ASNU=BHTX(5)                                                      AC 5310
      WRITE (6,529) AVTIAT,AVTIWB,AVTIDP,AVTIW,AVTIH                    AC 5320
      WRITE (6,469) AVFIDBT,AVFIWB,AVTIDP,AVFIW,AVFIH                   AC 5330
      WRITE (6,539) HWIT,AVXOWT,DRYFLO,GPMDRY,PERDRY,CMF,AIRER          AC 5340
      WRITE (6,549) RE,HA,ASNU,ST,XJ                                    AC 5350
      WRITE (6,559) HTXEE,HTXEW,EHTX                                    AC 5360
  209 CONTINUE                                                          AC 5370
      IF (GPMDRY.GT.1000.0) GO TO 219                                   AC 5380
      EHTX=0.0                                                          AC 5390
      DRYFLO=EHTX                                                       AC 5400
      XJ=DRYFLO                                                         AC 5410
      ASNU=XJ                                                           AC 5420
```

(Continued)

Table C-4 (cont'd)

```
      HA=ASNU                                                             AC 5430
      RE=HA                                                               AC 5440
  219 CONTINUE                                                            AC 5450
C                                                                         AC 5460
C     CALCULATE TOTAL HEAT TRANSFER(BTU/HR) FROM WATER IN TOWER           AC 5470
C     FOR PLUME DATA OUTPUT                                               AC 5480
C                                                                         AC 5490
      THTFW=2.0*(HTXEW+EEWS)                                              AC 5500
C                                                                         AC 5510
C     CALCULATION FAN-STACK-MOTOR EFFICIENCY                              AC 5520
C                                                                         AC 5530
      ETAFAN=TMF*SSP*5.204/(3600.0*RHOAIR(AVSEW,AVSET,BARPSI)*FANPWR*FAN AC 5540
     1CON)                                                                AC 5550
      SRHO=RHOAIR(AVSEW,AVSET,BARPSI)                                     AC 5560
C                                                                         AC 5570
C     FAN FLOW RATE IN CFM                                                AC 5580
C                                                                         AC 5590
      Q=TMF*(1.0+AVSEW)/(60.0*SRHO)                                       AC 5600
C                                                                         AC 5610
C     HEAD COEFFICIENT (INWG/RPM**2-FT**2)                                AC 5620
C                                                                         AC 5630
      SCI=SSP/(RPM**2*FBDIA**2)                                           AC 5640
C                                                                         AC 5650
C     FLOW COEFFICIENT (CFM/RPM-FT**3)                                    AC 5660
C                                                                         AC 5670
      PHI=Q/(RPM*FBDIA**3)                                                AC 5680
C                                                                         AC 5690
C     NONDIMENSIONAL HEAD COEFFICIENT                                     AC 5700
C                                                                         AC 5710
      SCIND=(SSP*5.204*32.174/62.426)/(RPM*2.0*PI*FBDIA/60.0)**2         AC 5720
C                                                                         AC 5730
C     NONDIMENSIONAL FLOW COEFFICIENT                                     AC 5740
C                                                                         AC 5750
      PHIND=Q/(RPM*2.0*PI*FBDIA**3)                                       AC 5760
```

(Continued)

Table C-4 (cont'd)

```
      HP=FANPWR*FANCON/550.0                                             AC 5770
      WRITE (6,569) TV,FA,HP,RPM,FANANG,SSP,Q,ETAFAN,SCI,PHI,SCIND,PHIND AC 5780
      IF (ISTATP.EQ.1) WRITE (6,639) QFAN                                AC 5790
      IF (IPUN.EQ.0) GO TO 319                                           AC 5800
      I=ICODE(1)                                                         AC 5810
      WRITE (7,579)                                                      AC 5820
      DO 309 J=1,5                                                       AC 5830
        MM=IPUNCH(I,J)                                                   AC 5840
        GO TO (229,239,249,259,299,309), MM                              AC 5850
  229   WRITE (7,589) ICODE,IDATE,XL,G,WETFLO,CMF,XKA,XNTU,AVFIDBT,AVTO  AC 5860
     1  AT,AVTIDP,AVTODP,DBT,FAVOWT,CWRT,WLWF,WECE                       AC 5870
        GO TO 309                                                        AC 5880
  239   WRITE (7,599) ICODE,IDATE,RE,HA,ASNU,XJ,CMF,AVTIAT,AVTIDP,AVFID  AC 5890
     1  BT,HWIT,AVXOWT,DRYFLO,EHTX                                       AC 5900
        GO TO 309                                                        AC 5910
  249   WRITE (7,609) ICODE,IDATE,SSP,Q,RPM,FANANG,HP,PHI,SCI,PHIND,SCI  AC 5920
     1  ND,ETAFAN                                                        AC 5930
        GO TO 309                                                        AC 5940
  259   IEND=NCT2(INX)                                                   AC 5950
        DO 279 I=1,IEND                                                  AC 5960
          IF (IELEV(I,INX).NE.200) GO TO 269                             AC 5970
          ZO=30.0                                                        AC 5980
          DBPL=DBP(I,INX)                                                AC 5990
          WBDPP=WBDP(I,INX)                                              AC 6000
          AVELPP=AVELP(I,INX)                                            AC 6010
  269     CONTINUE                                                       AC 6020
          IF (IELEV(I,INX).NE.201) GO TO 279                             AC 6030
          ZO=75.0                                                        AC 6040
          DBPL=DBP(I,INX)                                                AC 6050
          WBDPP=WBDP(I,INX)                                              AC 6060
          AVELPP=AVELP(I,INX)                                            AC 6070
          GO TO 289                                                      AC 6080
  279   CONTINUE                                                         AC 6090
  289   WBDPP=(DBPL-WBDPP)*(9.0/5.0)+32.0                                AC 6100
```

(Continued)

Table C-4 (cont'd)

```
        DBPL=DBPL*(9.0/5.0)+32.0                                        AC 6110
        RH=RELHUM(SPHUM(DBPL,WBDPP,BARPSI),BARPSI,DBPL)                 AC 6120
        AVELPP=AVELPP*3.281                                             AC 6130
        WRITE (7,619) ICODE,AFAN(3),SHEIG,AVSET,SEV,SERH,AVF,THTFW,DBPL AC 6140
     1  ,RH,AVELPP,ZO,VISIO(INX)                                        AC 6150
        GO TO 309                                                       AC 6160
  299   WRITE (6,629)                                                   AC 6170
  309 CONTINUE                                                          AC 6180
  319 INX=INX+1                                                         AC 6190
      IF (INX.GT.IFLAG) STOP                                            AC 6200
      WRITE (6,579)                                                     AC 6210
      WRITE (7,579)                                                     AC 6220
      GO TO 109                                                         AC 6230
C                                                                       AC 6240
  329 FORMAT (46X, 18HAMBIENT AIR STATES,/37X, 23HTEMPERATURE(DEG. F)/DE AC 6250
     1W,1X, 13HPOINT(DEG. F),//39X,F5.1,  1H/,F5.1,10X,F5.1,  1H/,F5.1// AC 6260
     2/44X, 26HBAROMETRIC PRESSURE(IN HG),/52X,F5.2///)                 AC 6270
  339 FORMAT (44X, 22HTOWER INLET AIR STATES,/37X, 20HTEMPERATURE(DEG. F AC 6280
     1)/, 17HDEWPOINT(DDEG. F),//49X,F5.1,  1H/,F5.1/,(28X,F5.1,  1H/,F5 AC 6290
     2.1,10X,F5.1,  1H/,F5.1,10X,F5.1,  1H/,F5.1))                      AC 6300
  349 FORMAT (///36X, 38HWET FILL INLET AIR TEMPERATURE(DEG. F),//49X,F5 AC 6310
     1.1/,(28X,F5.1,15X,F5.1,15X,F5.1))                                 AC 6320
  359 FORMAT (///41X, 26HWET FILL OUTLET AIR STATES,/37X, 11HTEMPERATURE AC 6330
     1, 26H(DEG. F)/DEW POINT(DEG. F),//49X,F5.1,  1H/,F5.1/,(28X,F5.1,  AC 6340
     2 1H/,F5.1,10X,F5.1,  1H/,F5.1,10X,F5.1,  1H/,F5.1))               AC 6350
  369 FORMAT (///47X, 16HSTACK AIR STATES,/37X, 19HTEMPERATURE(DEG. F),  AC 6360
     116H/DEWPINT(DEG. F),//7X,5(F5.1,  1H/,F5.1,10X))                  AC 6370
  379 FORMAT (1H1,42X, 26HWATER TEMPERATURES(DEG. F),/5X, 15HHOT WATER I AC 6380
     1NLET,2X, 18HDISTRIBUTION BASIN,2X, 21HHEAT EXCHANGER OUTLET,2X,  4 AC 6390
     2HHEAT,1X, 16HEXCHANGER OUTLET,2X, 17HCOLD WATER RETURN,//7X,2X,F5. AC 6400
     31,14X,F5.1,17X,F5.1,17X,F5.1,16X,F5.1///)                         AC 6410
  389 FORMAT (36X, 42HFILL WATER TEMPERATURE DISTRIBUTION(DEG.F),/27X, 5 AC 6420
     14H(LEFT-TO-RIGHT IS EQUIVALENT TO FRONT-TO-REAR IN FILL),//51X,  7 AC 6430
     2HLEVEL I,/51X,F5.1/36X,3(F5.1,10X)/30X,4(F5.1,10X)/36X,3(F5.1,10X) AC 6440
```

(Continued)

Table C-4 (cont'd)

```
   3,/51X,F5.1//)                                                        AC 6450
399 FORMAT (50X,  8HLEVEL II,/30X,4(F5.1,10X))                           AC 6460
409 FORMAT (//49X,  9HLEVEL III,/51X,F5.1/36X,3(F5.1,10X)/30X,4(F5.1,1  AC 6470
   10X)/36X,3(F5.1,10X),/51X,F5.1//)                                     AC 6480
419 FORMAT (50X,  8HLEVEL IV,/30X,4(F5.1,10X))                           AC 6490
429 FORMAT (///40X, 30HTOWER INLET VELOCITIES(FT/SEC),//,(39X,3(F4.1,1  AC 6500
   10X)))                                                                AC 6510
439 FORMAT (///41X, 28HSTACK AIR VELOCITIES(FT/SEC),//,(39X,3(F4.1,10X  AC 6520
   1)))                                                                  AC 6530
449 FORMAT (///29X, 49HSTACK STATIC PRESSURE BELOW ATMOSPHERIC PRESSUR  AC 6540
   1E ,  3HWAS,1X,E10.3,1X,  5HIN WG,///)                                AC 6550
459 FORMAT (1H1,20X,20(  1H-), 32HWET TOWER HEAT AND MASS TRANSFER,1X,  AC 6560
   1  7HRESULTS,20(  1H-)//1X, 36HAVERAGE AIR INLET TEMPERATURE(DEG.F)  AC 6570
   2, 59H/WET BULB(DEG.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM),   AC 6580
   318H/ENTHALPY(BTU/LBM),//24X,F5.1,15X,F5.1,10X,F5.1,13X,F6.5,14X,F5  AC 6590
   4.1///)                                                               AC 6600
469 FORMAT (1X, 51HAVERAGE AIR OUTLET TEMPERATURE(DEG.F)/WET BULB(DEG.  AC 6610
   1,1X, 54HF)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY,  9  AC 6620
   2H(BTU/LBM),//25X,F5.1,15X,F5.1,12X,F5.1,13X,F6.5,14X,F5.1///)       AC 6630
479 FORMAT (1X, 44HCALCULATED AIR OUTLET TEMPERATURE(DEG.F)/WET,1X, 54  AC 6640
   1HBULB(DEG.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM), 18H/ENTHA  AC 6650
   2LPY(BTU/LBM),//17X,F5.1,28X,F5.1,9X,F5.1,14X,F6.5,19X,F5.1///)      AC 6660
489 FORMAT (18X, 30HWATER INLET TEMPERATURE(DEG.F),10X, 12HWATER OUTLE  AC 6670
   1T,1X, 18HTEMPERATURE(DEG.F),//30X,F5.1,36X,F5.1///6X,  5HWATER,1X,  AC 6680
   2 22HFLOWRATE(LBM/HR)/(GPM),10X, 30HPERCENT DIFFERENCE IN FLOWRATE,  AC 6690
   310X, 27HWATER LOADING(LBM/HR-FT-FT),/52X, 15HAS PERCEIVED BY,/46X,  AC 6700
   4 28HTHE MANOMETER AND TRANSDUCER,//5X,E10.3,  1H/,E10.3,26X,F6.1,3  AC 6710
   50X,E10.3///2X, 24HDRY AIR FLOWRATE(LBM/HR),10X, 11HAIR LOADING, 14  AC 6720
   6H(LBM/HR-FT-FT),10X, 32HPERCENT DIFFERENCE BETWEEN STACK,/75X, 14H  AC 6730
   7AND TOWER FACE,1X,  8HFLOWRATE,//11X,E10.3,22X,E10.3,32X,F6.1///2X  AC 6740
   8,  6HNUMBER,1X, 27HOF VERTICAL TOWER DIVISIONS,3X, 26HNUMBER OF HO  AC 6750
   9RIZONTAL TOWER,1X,  9HDIVISIONS,3X, 10HHEIGHT(FT),3X.  9HWIDTH(FT)  AC 6760
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(Continued)

Table C-4 (cont'd)

```
    *,3X,  9HDEPTH(FT),//17X,I3,35X,I3,22X,F5.1,7X,F5.1,6X,F5.1///)
499 FORMAT (2X, 38HMASS TRANSFER COEFFICIENT(LBM/HR-FT-3),5X,  6HNUMBE
    1R,1X, 17HOF TRANSFER UNITS,5X, 25HWATER LOSS BY EVAPORATION, 16H(L
    2BM/HR) IN FILL,//18X,F6.1,32X,F5.3,27X,F8.1,///)
509 FORMAT (8X, 27HWATER LOSS(LBM/HR) IN TOWER,5X, 18HFILL WATER LOSS
    1AS,5X, 18HFILL WATER LOSS AS,/41X, 12HA PERCENT OF,1X,  3HAIR,6X,
    218HA PERCENT OF WATER,/44X,  8HFLOWRATE,15X,  8HFLOWRATE,//16X,F8.
    31,20X,F7.1,16X,F7.1,///)
519 FORMAT (1H1,4X,  6HENERGY,1X, 14HEXCHANGE BASED,5X, 27HPERCENT ERR
    1OR IN CALCULATED,5X, 21HENERGY EXCHANGE BASED,5X, 19HENERGY CONSER
    2VATION,/8X, 13HON AIR STATES,13X, 19HAIR ENERGY EXCHANGE,12X,  2HO
    3N,1X, 12HWATER STATES,10X, 14HERROR(PERCENT),//5X,E10.3,22X,F6.1,3
    40X,E10.3,18X,F6.1///)
529 FORMAT (1H1,20X,19(  1H-), 31HDRY TOWER HEAT TRANSFER RESULTS,19(
    1 1H-)//1X, 36HAVERAGE AIR INLET TEMPERATURE(DEG.F), 50H/WET BULB(D
    2EG.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY, 27H(LBM/LBM)/ENTHALPY(BTU
    3/LBM),//24X,F5.1,12X,F5.1,12X,F5.1,16X,F6.5,18X,F5.1///)
539 FORMAT (18X, 30HWATER INLET TEMPERATURE(DEG.F),10X,  5HWATER,1X, 2
    15HOUTLET TEMPERATURE(DEG.F),//33X,F5.1,40X,F5.1///16X, 28HWATER FL
    2OWRATE(LBM/HR)/(GPM),10X, 21HPERCENT DIFFERENCE IN,1X,  8HFLOWRATE
    3,/62X, 15HAS PERCEIVED BY,/56X, 13HTHE MANOMETER,1X, 14HAND TRANSD
    4UCER,//15X,E10.3,  1H/,E10.3,24X,F6.1///18X,  3HAIR,1X, 16HFLOWRAT
    5E(LBM/HR),10X, 32HPERCENT DIFFERENCE BETWEEN STACK,/52X, 23HAND TO
    6WER FACE FLOWRATE,//23X,E10.3,32X,F6.1///)
549 FORMAT (1X, 24HAIR-SIDE REYNOLDS NUMBER,10X, 16HFILM COEFFICIENT,1
    10X, 14HNUSSELT NUMBER,10X, 14HSTANTON NUMBER,10X,  8HJ FACTOR,//,8
    22X,E10.3,21X,F5.1,21XX,F5.1,20X,F4.3,17X,F4.3///)
559 FORMAT (11X, 21HENERGY EXCHANGE BASED,10X, 15HENERGY EXCHANGE,1X,
    1 5HBASED,10X, 25HENERGY CONSERVATION ERROR,/15X,  6HON AIR,1X,  6H
    2STATES,16X, 15HON WATER STATES,//15X,E10.3,22X,E10.3,27X,F6.1///)
569 FORMAT (1H1,20X,26(  1H-), 17HFAN-STACK RESULTS,26(  1H-),//,32X,
    114HFAN VOLTAGE(V),20X, 10HCURRENT(A),20X,  9HPOWER(KW),//31X,E10.3
    2,13X,3E1Z,3,12X,E10.3///,12X,  3HRPM,5X, 11HBLADE ANGLE,5X, 20HPRE
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(Continued)

Table C-4 (cont'd)

```
     3SSURE RISE(IN WG),5X, 13HFLOWRATE(CFM),5X, 26HCOMBINED STATIC EFFI AC 7100
     4CIENCY,//12X,F5.1,9X,F4.1,18X,F6.3,9X,E10.1,20X,F5.3///,18X, 34HHE AC 7110
     5AD COEFFICIENT(IN WG/RPM-2-FT-2),10X, 30HFLOW COEFFICIENT(CFM/RPM- AC 7120
     6FT-3),//30X,E10.3,33X,E10.3///20X, 31HHEAD COEFFICIENT(DIMENSIONLE AC 7130
     7SS),10X,  4HFLOW,1X, 26HCOEFFICIENT(DIMENSIONLESS),//31X,E10.3,33X AC 7140
     8,E10.3///)                                                          AC 7150
  579 FORMAT (1H1)                                                        AC 7160
  589 FORMAT (6I1,1X,I3,1X,6E11.4,/,7E11.4,/,7E11.4)                      AC 7170
  599 FORMAT (6I1,1X,I3,1X,6E11.4,/,7E11.4)                               AC 7180
  609 FORMAT (6I1,1X,I3,6E11.4,/,7E11.4)                                  AC 7190
  619 FORMAT (7( 10HPLUME DATA)/,1X,6I1/,5F10.1,2E10.4/4F10.1,E10.3)      AC 7200
  629 FORMAT (1X,40(  1H-), 29HACOUSTIC FORMATS ARE REQUIRED,40(  1H-),/ AC 7210
     1/)                                                                  AC 7220
  639 FORMAT (42X, 28HAIR FLOW FROM FAN CURVE(CFM),/51X,E10.3///)         AC 7230
C                                                                         AC 7240
      END                                                                 AC 7250
```

SUBROUTINE HTX (A,B)

```
      SUBROUTINE HTX (A,B)                                                A  10
C                                                                         A  20
C     THIS SUBROUTINE IS DESIGNED FOR AN EQUAL NUMBER OF TUBES            A  30
C     PER ROW.  IF THIS DOES NOT OCCUR IT IS NECESSARY TO ADD             A  40
C     THE EXTRA TUBES.  THIS IS DONE BY SPECIFYING ANTR.                  A  50
C     INPUT:                                                              A  60
C     A(1)=DO=TUBE OD(IN)                                                 A  70
C     A(2)=DI=TUBE ID (IN)                                                A  80
C     A(3)=DOF=FIN OD (IN)                                                A  90
C     A(4)=DC=COLLAR OD (IN)                                              A 100
C     A(5)=PT=TUBE TRANSVERSE PITCH (IN)                                  A 110
C     A(6)=T=FIN THICKNESS (IN)                                           A 120
C     A(7)=XNF=NUMBER OF FINS PER INCH (1/IN)                             A 130
C     A(8)=XNR=NUMBER OF TUBE ROWS                                        A 140
C     A(9)=XNTPR=NUMBER OF TUBES PER ROW                                  A 150
C     A(10)=XLF=CHARACTERISTIC AIR FLOW LENGTH(FT)                        A 160
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(Continued)

Table C-4 (cont'd)

```
C     THROUGH HEAT EXCHANGER (FT)
C     A(11)=XLT=TUBE LENGTH (FT)                                         A 170
C     A(12)=XKT=TUBE THERMAL CONDUCTIVITY (BTU/HR-FT**2-DEG F)           A 180
C     A(13)=XKF=FIN THERMAL CONDUCTIVITY (BTU/HR-FT-DEG F)               A 190
C     A(14)=HC=FIN-TO-TUBE CONTACT RESISTANCE(BTU/HR-FT**2-DEG. F)       A 200
C     A(15)=XMA=AIR MASS FLOWRATE (LBM/HR)                               A 210
C     A(16)=XMW=WATER MASS FLOWRATE (LBM/HR)                             A 220
C     A(17)=TAI=AVERAGE AIR INLET TEMPERATURE (DEG F)                    A 230
C     A(18)=TAO=AVERAGE AIR OUTLET TEMPERATURE (DEG F)                   A 240
C     A(19)=TWI=WATER INLET TEMPERATURE (DEG F)                          A 250
C     A(20)=TWO=WATER OUTLET TEMPERATURE (DEG F)                         A 260
C     A(21)=PBARO=BAROMETRIC PRESSURE (PSIA)                             A 270
C     OUTPUT:                                                            A 280
C     B(1)=HA=AIR SIDE HEAT TRANSFER COEFFICIENT (BTU/HR-FT**2-DEG F)    A 290
C     B(2)=RE=AIR SIDE REYNOLDS NUMBER                                   A 300
C     B(3)=ST=AIR SIDE STANTON NUMBER                                    A 310
C     B(4)=STANTON NUMBER=PRANDTL NUMBER TO 2/3 PRODUCT                  A 320
C     B(5)=AIR SIDE NUSSELT NUMBER                                       A 330
C                                                                        A 340
      DIMENSION A(21), B(5)                                              A 350
      DO=A(1)                                                            A 360
      DI=A(2)                                                            A 370
      DOF=A(3)                                                           A 380
      DC=A(4)                                                            A 390
      PT=A(5)                                                            A 400
      T=A(6)                                                             A 410
      XNF=A(7)                                                           A 420
      XNR=A(8)                                                           A 430
      XNTPR=A(9)                                                         A 440
      XLF=A(10)                                                          A 450
      XLT=A(11)                                                          A 460
      XKT=A(12)                                                          A 470
      XKF=A(13)                                                          A 480
      HC=A(14)                                                           A 490
                                                                         A 500
```

(Continued)

Table C-4 (cont'd)

```
      XMA=A(15)
      XMW=A(16)
      TAI=A(17)
      TAO=A(18)
      TWI=A(19)
      TWO=A(20)
C
C     EXTRA TUBES ABOVE THAT CALCULATED USING AN EQUAL NUMBER OF
C     TUBES/ROW
C
      ANTR=8.0
      PBARO=A(21)
      PI=3.14
      TOL=1.0E-8
C
C     TOTAL OUTSIDE TUBE AREA
C
      ATS=PI*DC/12.0*(1.0-XNF*T)*XLT*(XNTPR*XNR+ANTR)
C
C     TOTAL FIN AREA
C
      AFS=2.0*12.0*XNF*XLT*(XNTPR*XNR+ANTR)*PI*(DOF**2-DC**2)/(4.0*144.0
     1)
C
C     TOTAL TUBE INSIDE AREA
C
      AITS=PI*(DI/12.0)*XLT*(XNTPR*XNR+ANTR)
C
C     AVERAGE AIR TEMPERATURE THROUGH THE HEAT EXCHANGER
C
      TOA=(TAI+TAO)/2.0
C
C     AIR PROPERTIES AT THE AVERAGE AIR TEMPERATURE
C
```

(Continued)

Table C-4 (cont'd)

```
      CALL AIRPRO (TOA,XMU,XK,CP,PR)
C
C     CALCULATE SPECIFIC HEAT OF WATER AT INLET AND OUTLET
C      TEMPERATURE
C
      CALL WATPRO (TWI,GARB,GARB,CPWI,GARB,BARG)
      CALL WATPRO (TWO,GARB,GARB,CPWO,GARB,GARB)
C
C     TOTAL HEAT TRANSFERRED
C
      Q=XMW*(CPWI*TWI-CPWO*TWO)
C
C     AVERAGE AIR TEMPERATURE
C
      TOA=(TAI+TAO)/2.0
C
C     AVERAGE WATER TEMPERATURE
C
      TIA=(TWI+TWO)/2.0
C
C     ASSUME A WALL TEMPERATURE
C
      TW=(TOA+TWI)/2.0
C
C     ASSUME AN OUTSIDE AIR FILM COEFFICIENT
      HA=15.0
C
C     FIN PARAMETERS
C
      W=(DOF-DC)/(2.0*12.0)
      XE=DOF/2.0
      XB=DC/2.0
      DO 109 I=1,3
         UB=W*SQRT(24.0*HA/(XKF*T))/(XE/XB-1.0)
         UE=UB*(XE/XB)
```

(Continued)

Table C-4 (cont'd)

```
      CALL BESLI (UE,TOL,EAO,EI1)                                       A 1210
      CALL BESLK (UE,EIO,EI1,TOL,EKO,EK1)                               A 1220
      CALL BESLI (UB,TOL,BIO,BI1)                                       A 1230
      CALL BESLK (UB,BIO,BI1,TOL,BKO,BK1)                               A 1240
      BETA=EI1/EK1                                                      A 1250
C                                                                       A 1260
C     FIN EFFICIENCY                                                    A 1270
C                                                                       A 1280
      ETA=(2.0/(UB*(1.0-(UE/UB)**2)))*(BI1-BETA*BK1)/(BIO+BETA*BKO)     A 1290
C                                                                       A 1300
C     WATER PROPERTIES                                                  A 1310
C                                                                       A 1320
      CALL WATPRO (TW,XMUW,XKW,GARB,PRW,RHOW)                           A 1330
      CALL WATPRO (TIA,XMUWL,XKWL,GARB,PRWL,RHOWL)                      A 1340
C                                                                       A 1350
C     CALCULATE WATER SIDE FILM COEFFICIENT                             A 1360
C                                                                       A 1370
      V=4.0*XMW/(RHOW*(XNTPR*XNR+ANTR)*PI*(DI/12.0)**2)                 A 1380
      REW=RHOW*V*DI/(XMUW*12.0)                                         A 1390
      XNU=.027*REW**.8*PRW**(1.0/3.0)*(XMUW/XMUWL)**.14                 A 1400
      H=XKW*12.0*XNU/DI                                                 A 1410
C                                                                       A 1420
C     CALCULATE CROSS FLOW LMTD CORRECTION                              A 1430
C                                                                       A 1440
      F=CORF(TWI,TWO,TAI,TAO)                                           A 1450
C                                                                       A 1460
C     LMTD                                                              A 1470
C                                                                       A 1480
      DELT=(TWI-TAO-TWO+TAI)/ALOG((TWI-TAO)/(TWO-TAI))                  A 1490
      HAEST=Q/((ATS+ETA*AFS)*(F*DELT-Q*(1.0/(H*AITS)+ALOG(DO/DI)/(2.0   A 1500
     1*PI*XKT*XLT*(XNTPR*XNR+ANTR))+1.0/(HC*PI*(DO/12.0)*XLT*(XNTPR*X   A 1510
     2NR+ANTR))+ALOG(DC/DO)/(2.0*PI*XKF*XLT*(XNTPR*XNR+ANTR)))))        A 1520
      ERROR=ABS(HAEST-HA)                                               A 1530
      HA=HAEST                                                          A 1540
      IF (ERROR.LE..01) GO TO 119                                       A 1550
```

(Continued)

Table C-4 (cont'd)

```
C                                                                        A 1560
C     CALCULATE OUTER RESISTANCE                                         A 1570
C                                                                        A 1580
         RO=1.0/(HA*(ATS+ETA*AFS))+1.0/(HC*PI*(DO/12.0)*XLT*(XNTPR*XNR+A  A 1590
     1   NTR))+ALOG(DC/DO)/(2.0*PI*XKF*XLT*(XNTPR*XNR+ANTR))+ALOG(DO/DI)  A 1600
     2   /(2.0*PI*XKT*XLT*(XNTPR*XNR+ANTR))                               A 1610
C                                                                        A 1620
C     INNER RESISTANCE                                                   A 1630
C                                                                        A 1640
         RI=1.0/(H*AITS)                                                 A 1650
C                                                                        A 1660
C     RECALCULATE WALL TEMPERATURE                                       A 1670
C                                                                        A 1680
  109 TW=(TOA*RI+TIA*RO)/(RO+RI)                                         A 1690
  119 CALL AIRPRO (TOA,XMU,XK,CP,PR)                                     A 1700
C                                                                        A 1710
C     MINIMUM FREE FLOW AREA                                             A 1720
C                                                                        A 1730
      AC=((PT-DC)/12.0)*(XNTPR+4.0)*XLT*(1.0-XNF*T)                      A 1740
      G=XMA/AC                                                           A 1750
C                                                                        A 1760
C     STANTON NUMBER                                                     A 1770
C                                                                        A 1780
      ST=HA/(G*CP)                                                       A 1790
C                                                                        A 1800
C     HYDRAULIC DIAMETER                                                 A 1810
C                                                                        A 1820
      DH=4.0*AC*XLF/(ATS+AFS)                                            A 1830
C                                                                        A 1840
C     REYNOLDS NUMBER                                                    A 1850
C                                                                        A 1860
      RE=G*DH/XMU                                                        A 1870
C                                                                        A 1880
C     STANTON-PRANDTL-NUMBER TO 2/3-POWER PRODUCT                        A 1890
C                                                                        A 1900
```

(Continued)

Table C-4 (cont'd)

```
      STPR23=ST*PR**.666667                                             A1910
C                                                                       A1920
C     NUSSELT NUMBER                                                    A1930
C                                                                       A1940
      XNU=HA*DH/XK                                                      A1950
C                                                                       A1960
C     OUTPUT ARRAY                                                      A1970
C                                                                       A1980
      B(1)=HA                                                           A1990
      B(2)=RE                                                           A2000
      B(3)=ST                                                           A2010
      B(4)=STPR23                                                       A2020
      B(5)=XNU                                                          A2030
      RETURN                                                            A2040
C                                                                       A2050
      END                                                               A2060
      FUNCTION HV(T)                                                    B  10
C                                                                       B  20
C     HV CALCULATES THE SATURATED WATER VAPOR ENTHALPY (BTU/LBM)        B  30
C     GIVEN THE SATURATION TEMPERATURE (DEG.F)                          B  40
C                                                                       B  50
      DIMENSION HVTAB(54), TEMTAB(54)                                   B  60
      DATA HVTAB/1061.8,1066.2,1070.6,1074.9,1075.8,1076.7,1077.6,1078.4B  70
     1,1079.3,1080.2,1081.0,1081.9,1082.8,1083.7,1084.5,1085.4,1086.3,10B  80
     287.1,1088.0,1088.9,1089.7,1090.6,1091.5,1092.3,1093.2,1094.1,1094.B  90
     39,1095.8,1096.6,1097.5,1098.4,1099.2,1100.1,1100.9,1101.8,1102.6,1B 100
     4103.5,1104.4,1105.2,1106.1,1106.9,1107.8,1108.6,1109.5,1110.3,1111B 110
     5.1,1112.0,1112.8,1113.7,1114.5,1115.3,1116.2,1117.0,1117.9/       B 120
      DATA TEMTAB/0.0,10.0,20.0,30.0,32.,34.,36.,38.,40.,42.,44.,46.,48.B 130
     1,50.,52.,54.,56.,58.,60.,62.,64.,66.,68.,70.,72.,74.,76.,78.,80.,8B 140
     22.,84.,86.,88.,90.,92.,94.,96.,98.,100.,102.,104.,106.,108.,110.,1B 150
     312.,114.,116.,118.,120.,122.,124.,126.,128.,130./                 B 160
      HV=SINTRP(TEMTAB,HVTAB.T.54)                                      B 170
```

(Continued)

Table C-4 (cont'd)

```
      RETURN
C
      END
      FUNCTION HF(T)
C
C     HF CALCULATES THE SATURATED LIQUID WATER ENTHALPY (BTU/LBM)
C     GIVEN THE SATURATION TEMPERATURE (DEG.F).  IF THE TEMPERATURE
C     IS BELOW 32 DEG.F THE VALUES FOR ICE WILL BE USED.
C     GIVEN THE SATURATION TEMPERATURE (DEG.F).  IF THE TEMPERATURE
C     IS BELOW 32 DEG.F THE VALUES FOR ICE WILL BE USED.
C
      DIMENSION HFTAB(50), TEMTAB(50), HITAB(5), TITAB(5)
      DATA HFTAB/0.,2.02,4.03,6.04,8.05,10.05,12.06,14.06,16.07,18.07,20
     1.07,22.07,24.06,26.06,28.06,30.05,32.05,34.05,36.04,38.04,40.04,42
     2.03,44.03,46.02,48.02,50.01,52.01,54.00,56.00,57.99,59.99,61.98,63
     3.98,65.97,67.97,69.96,71.96,73.95,75.95,77.94,79.94,81.93,83.93,85
     4.92,87.92,89.92,91.91,93.91,95.91,97.90/
      DATA TEMTAB/32.0,34.0,36.0,38.0,40.0,42.0,44.0,46.0,48.0,50.0,52.0
     1,54.0,56.0,58.0,60.0,62.0,64.0,66.0,68.0,70.0,72.0,74.0,76.0,78.0,
     280.0,82.0,84.0,86.0,88.0,90.0,92.0,94.0,96.0,98.0,100.0,102.0,104.
     30,106.0,108.0,110.0,112.0,114.0,116.0,118.0,120.0,122.0,124.0,126.
     40,128.0,130.0/
      DATA HITAB/-158.93,-154.17,-149.31,-144.35,-143.35/
      DATA TITAB/0.0,10.0,20.0,30.0,32.0/
      IF (T.LT.32.0) GO TO 109
      HF=SINTRP(TEMTAB,HFTAB,T,50)
      RETURN
  109 HF=SINTRP(TITAB,HITAB,T,5)
      RETURN
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      FUNCTION AVG(X,N)
C
C     X=ARRAY TO BE AVERAGED
C     N=NUMBER OF ELEMENTS IN X
C
      DIMENSION X(N)
      AVG=0.0
      DIV=FLOAT(N)
      DO 119 I=1,N
         IF (X(I).GT.997.0) GO TO 109
         AVG=AVG+X(I)
         GO TO 119
  109    DIV=DIV-1.0
  119 CONTINUE
      AVG=AVG/DIV
      RETURN
C
      END
      FUNCTION PV(T)
C
C     WHERE T IS THE TEMPERATURE IN DEG.F AND PV THE
C     CORRESPONDING SATURATION PRESSURE (PSIA)
C     REFERENCE - ASHRAE HANDBOOK OF FUNDAMENTALS, 1977
C
      DIMENSION F(8)
      DATA F/-741.9242,-29.721,-11.55286,-.8685635,.1094098,.439993,.252
     10658,.05218684/
      THETA=273.16/(((T-32.0)*5.0/9.0)+273.16)
      IF (THETA.GT.10.) THETA=10.0
      IF (THETA.LE.0.0) THETA=10.0
      IF (T.GE.32.0) GO TO 109
      XLOGPV=-9.096936*(THETA-1.0)-3.56654*ALOG10(THETA)+.876817*(1.0-1.
     10/THETA)-2.2195983
      PV=(10.0**XLOGPV)*14.696
      RETURN
  109 IF (T.GE.212.0) GO TO 119
```

(Continued)

Table C-4 (cont'd)

```
      XLOGPV=10.79586*(1.0-THETA)+5.02808*ALOG10(THETA)+1.50474E-4*(1.0-
     110.0**(-8.29692*(1.0/THETA-1.0)))+.42873E-3*(10.0**(4.76955*(1.0-T
     2HETA))-1.0)-2.2195983
      PV=14.696*(10.0**XLOGPV)
      RETURN
  119 IF (T.GT.705.0) WRITE (6,139)
      TC=273.16/THETA-273.16
      SUM=F(1)
      DO 129 I=2,8
  129 SUM=SUM+F(I)*(.65-TC)**(I-1)
      XLOGE=.01*(374.136-TC)*SUM/THETA
      PV=(217.99*EXP(XLOGE))*14.696
      RETURN
C
  139 FORMAT (1X,17H---FUNCTION PV---,/,15HTEMPERATURE WAS,1X,41HOUT OF
     1RANGE.  PV WAS EXTRAPOLATED BEYOND,1X,23H705.0 DEG.F!   BE AWARE!)
C
      END
      FUNCTION SATHUM(T,PT)
C
C     SATHUM CALCULATES THE SATURATED SPECIFIC HUMIDITY
C     (LBM WATER/LBM DRY AIR) GIVEN THE SATURATION TEMPERATURE
C     T(DEG.F) AND THE AMBIENT PRESSURE (PSIA)
C
      PVWSAT=PV(T)
      SATHUM=.62198*PVWSAT/(PT-PVWSAT)
      RETURN
C
      END
      FUNCTION WETBLB(A,WB,UNNEC)
C
C     FUNCTION WETBLB IS USED BY ROOT TO CALCULATE THE WET BULB
C     (DEG.F) GIVEN THE DRY BULB (DEG.F), AND THE SPECIFIC HUMIDITY
C     (LBM WATER/LBM DRY AIR)
C     A(1)=DRY BULB (DEG.F)
```

(Continued)

Table C-4 (cont'd)

```
C     A(2)=SPECIFIC HUMIDITY (LBM WATER/LBM DRY AIR)                    G  70
C     A(3)=STATIC PRESSURE (PSIA)                                       G  80
C     WB=CURRENT ESTIMATE OF WET BULB TEMPERATURE                       G  90
C     UNNEC-AN UNUSED ARRAY                                             G 100
C     WETBLB- WET BULB TEMPERATURE BASED ON INPUT OF A AND WB           G 110
C                                                                       G 120
      DIMENSION A(3), UNNEC(1)                                          G 130
      TDB=A(1)                                                          G 140
      W=A(2)                                                            G 150
      PT=A(3)                                                           G 160
      WETBLB=(W*(HV(TDB)-HF(WB))-SATHUM(WB,PT)*(HV(WB)-HF(WB))+.24*TDB)/ G 170
     1.24                                                               G 180
      RETURN                                                            G 190
C                                                                       G 200
      END                                                               G 210
      FUNCTION TWB(TDB,PT,OMEGA,TOL)                                    H  10
C                                                                       H  20
C     FUNCTION TWB CALCULATES THE WET BULB TEMPERATURE GIVEN THE DRY    H  30
C     BULB, STATIC PRESSURE, SPECIFIC HUMIDITY, AND CONVERGENCE         H  40
C     TOLERANCES                                                        H  50
C     TDB=DRY BULB (DEG.F)                                              H  60
C     PT=STATIC PRESSURE (PSIA)                                         H  70
C     OMEGA=SPECIFIC HUMIDITY (LBM WATER/LBM DRY AIR)                   H  80
C     TOL(1)=ABSOLUTE CONVERGENCE ERROR (DEG.F)                         H  90
C     TOL(2)=RELATIVE CONVERGENCE ERROR (DEG.F)                         H 100
C                                                                       H 110
      DIMENSION A(3), AUXOUT(1), TOL(2)                                 H 120
      EXTERNAL WETBLB                                                   H 130
      HUMSAT=SATHUM(TDB,PT)                                             H 140
      IF (OMEGA.GT.HUMSAT) GO TO 109                                    H 150
      TRYWB=TDB/2.0                                                     H 160
      A(1)=TDB                                                          H 170
      A(2)=OMEGA                                                        H 180
      A(3)=PT                                                           H 190
```

(Continued)

Table C-4 (cont'd)

```
      CALL ROOT (WETBLB,A,TRYWB,TOL,TWB,AUXOUT,ISOLN)
      IF (ISOLN.EQ.0) WRITE (6,119) TWB
      RETURN
C
C     SINCE THE SPECIFIC HUMIDITY IS GREATER THAN THE SATURATED
C     VALUE CORRESPONDING TO THE DRY BULB TEMPERATURE, THE WET
C     BULB TEMPERATURE IS ASSUMED TO BE THE  DEWPOINT OF THE
C     AIRSATE CORRESPONDING TO THE GIVEN DRY BULB AND  ITS
C     SATURATED SPECIFIC HUMIDITY
C
  109 TWB=TSATV(HUMSAT*PT/(.62198+HUMSAT))
      RETURN
C
  119 FORMAT (1X,50H---FUNCTION TWB---/ROOT DID NOT ATTAIN CONVERGENCE,1
     1X,6HON THE,/1X,44HWET BULB TEMPERATURE!  THE VALUE RETURNED IS,F15
     2.4/)
C
      END
      FUNCTION WATOUT(A,ESTNTU)
C
C     FUNCTION CALCULATES THE AVERAGE WATER OUTLET TEMPERATURE FROM
C     THE TOWER.
C     A(1)=AVERAGE WATER INLET TEMPERATURE (DEG.F)
C     A(2)=AVERAGE AIR INLET ENTHALPY (BTU/LBM DRY AIR)
C     A(3)=AVERAGE AIR INLET DRY BULB TEMPERATURE (DEG.F)
C     A(4)=NUMBER OF AIR STREAMWISE TOWER DIVISIONS
C     A(5)=NUMBER OF AIR SPANWISE TOWER DIVISIONS
C     A(6)=AIR LOADING (LBM/HR-FT**2)
C     A(7)=WATER LOADING (LBM/HR-FT**2)
C     A(8)=STREAMWISE TOWER INTEGRATION LENGTH(FT)
C     A(9)=SPANWISE TOWER INTEGRATION LENGTH (FT)
C     A(10)=STATIC PRESSURE (PSIA)
C     A(11)=TOL(1)=ABSOLUTE ERROR IN WATER TEMPERATURE(DEG. F)
C     A(12)=TOL(2)=RELATIVE ERROR IN WATER TEMPERATURE
```

(Continued)

Table C-4 (cont'd)

```
C     A(13)=AVERAGE DRY BULB OUTLET TEMPERATURE (DEG.F)
C     A(14)=AVERAGE AIR OUTLET WET BULB ( DEG F )
C     A(15)=AVERAGE AIR OUTLET ENTHALPY(BTU/LBM DRY AIR)
C     A(16)=AVERAGE OUTLET SPECIFIC HUMIDITY(LBM WATER/LBM DRY AIR)
C     ----NOTE:  A(13) THROUGH A(16) IS OUTPUT.
C
      DIMENSION TA(100), HA(100), A(16), TW(100), TOL(2)
      IF (A(5).GT.100.0) GO TO 189
      IF (A(4).GT.100.0) GO TO 189
      TRANU=ESTNTU/A(5)
      DX=A(8)/A(4)
      DZ=A(9)/A(5)
      G=A(6)
      XL=A(7)
      SUM=0.0
      II=A(5)+1.0E-10
      JJ=A(4)+1.0E-10
      DO 109 I=1,II
         HA(I)=A(2)
  109 TA(I)=A(3)
      DTW=3.0
      TOL(1)=A(11)
      TOL(2)=A(12)
      DO 169 J=1,JJ
         TWAT=A(1)
         DO 159 I=1,II
            ISOL=0
  119       TWAVG=TWAT-DTW/2.0
            DH=DTW*XL*DX/(DZ*G)
            HAVG=HA(I)+DH/2.0
            WSAT=SATHUM(TWAVG,A(10))
            HASAT=AIRH(WSAT,A(10),TWAVG)
            DTWCAL=TRANU*(HASAT-HAVG)
            IF (ABS(DTWCAL-DTW).LE.TOL(1).OR.ABS((DTWCAL-DTW)/DTW).LE.TO
     1      L(2)) GO TO 149
```

(Continued)

Table C-4 (cont'd)

```
            ISOL=ISOL+1
            IF (ISOL.GT.1) GO TO 129
            DTWM1=DTW
            DTW=DTWCAL
            GO TO 139
  129       FRACT=(DTWCAL-DTWCAL2)/(DTW-DTWM1)
            Q=FRACT/(FRACT-1.0)
            DTWM1=DTW
            DTW=Q*DTW+(1.0-Q)*DTWCAL
  139       DTWCAL2=DTWCAL
            GO TO 119
  149       TWAT=TWAT-DTWCAL
            DTW=DTWCAL
            TA(I)=TA(I)+DH*(TWAVG-TA(I))/(HASAT-HA(I))
  159     HA(I)=HA(I)+DH
  169 SUM=SUM+TWAT
      TWO=SUM/A(4)
      SUM1=0.0
      SUM2=0.0
      DO 179 I=1,II
        SUM1=SUM1+TA(I)
  179 SUM2=SUM2+HA(I)
      TAO=SUM1/A(5)
      HAO=SUM2/A(5)
      CALL AIRPRO (TAO,G,G,CP,G)
      W=(HAO-CP*TAO)/HV(TAO)
      TWBOUT=TWB(TAO,A(10),W,TOL)
      A(13)=TAO
      A(14)=TWBOUT
      A(15)=HAO
      A(16)=W
      WATOUT=TWO
      RETURN
  189 WRITE (6,199)
      CALL EXIT
```

(Continued)

Table C-4 (cont'd)

```
 C                                                                        I 870
   199 FORMAT (1X,38H---NUMBER OF TOWER DIVISIONS TOO LARGE,1X,33HFOR PRE I 880
      1SENT DIMENSION IN WATOUT--,/)                                      I 890
 C                                                                        I 900
       END                                                                I 910
       FUNCTION TOWNTU(A,B,TOL)                                           J  10
 C                                                                        J  20
 C     FUNCTION CALCULATES THE AVERAGE TOWER NTU.                         J  30
 C     INPUT:                                                             J  40
 C     A(1)=AVERAGE WATER INLET TEMPERATURE (DEG.F)                       J  50
 C     A(2)=AVERAGE AIR INLET ENTHALPY (BTU/LBM DRY AIR)                  J  60
 C     A(3)=AVERAGE AIR INLET DRY BULB TEMPERATURE (DEG.F)                J  70
 C     A(4)=NUMBER OF AIR STREAMWISE TOWER DIVISIONS                      J  80
 C     A(5)=NUMBER OF AIR SPANWISE TOWER DIVISIONS                        J  90
 C      A(6)=AIR LOADING (LBM/HR-FT**2)                                   J 100
 C     A(7) =WATER LOADING (LBM/HR-FT**2)                                 J 110
 C     A(8)=STREAMWISE TOWER INTEGRATION LENGTH (FT)                      J 120
 C     A(9)=SPANWISE TOWER INTEGRATION LENGTH (FT)                        J 130
 C     A(10)=STATIC PRESSURE (PSIA)                                       J 140
 C     A(11)=AVERAGE WATER OUTLET TEMPERATURE (DEG.F)                     J 150
 C     OUTPUT:                                                            J 160
 C     B(1)=AVERAGE AIR OUTLET DRY BULB TEMPERATURE (DEG.F)               J 170
 C     B(2)=AVERAGE WET BULB OUTLET TEMPERATURE (DEG.F)                   J 180
 C     B(3)=AVERAGE AIR OUTLET ENTHALPY (BTU/LBM DRY AIR)                 J 190
 C     B(4)=TOWER MASS TRANSFER  COEFFICIENT (LBM/HR-FT**3)               J 200
 C     B(5)=AVERAGE AIR OUTLET SPECIFIC HUMIDITY(LBM WATER/LBM DRY AIR)   J 210
 C                                                                        J 220
       DIMENSION A(11), B(5), PARM(16), TOL(2)                            J 230
       EXTERNAL WATOUT                                                    J 240
       DH=(A(1)-A(11))*A(7)/A(6)*A(8)/A(9)                                J 250
       HAVG=A(2)+DH/2.0                                                   J 260
       TWAVG=(A(1)+A(11))/2.0                                             J 270
       HASAT=AIRH(SATHUM(TWAVG,A(10)),A(10),TWAVG)                        J 280
       TRANU=(A(1)-A(11))/(HASAT-HAVG)                                    J 290
       DO 109 I=1,10                                                      J 300
```

(Continued)

Table C-4 (cont'd)

```
  109 PARM(I)=A(I)                                                      J 310
C                                                                       J 320
C     WATER OUTLET TEMPERATURE MUST BE MORE ACCURATE BY A FACTOR        J 330
C     OF TEN AS COMPARED TO THE NTU ITERATION CONVERGENCE ERROR         J 340
C                                                                       J 350
      PARM(11)=TOL(1)/10.0                                              J 360
      PARM(12)=TOL(2)/10.0                                              J 370
      CALL TOWSOLV (WATOUT,PARM,TRANU,TRANU,A(11),TOWNTU,TOL,IEXT,10)   J 380
      B(1)=PARM(13)                                                     J 390
      B(2)=PARM(14)                                                     J 400
      B(3)=PARM(15)                                                     J 410
      B(4)=TOWNTU*A(7)/A(9)                                             J 420
      B(5)=PARM(16)                                                     J 430
      IF (IEXT.EQ.0) GO TO 119                                          J 440
      RETURN                                                            J 450
  119 WRITE (6,129)                                                     J 460
      CALL EXIT                                                         J 470
C                                                                       J 480
  129 FORMAT (1X,35H---SECANN DID NOT RETURN A SOLUTION,1X,14H  TO TOWNT J 490
     1U---,/)                                                           J 500
C                                                                       J 510
      END                                                               J 520
      SUBROUTINE TOWSOLV (FUNCT,AUXVAR,TRY1,TRY2,VAR,ANS,TOL,ISOLN,ITMAX K  10
     1)                                                                 K  20
C                                                                       K  30
C     TOWSOLV IS SECANN RENAMED TO AVOID IMPROPERLY NESTED CALLS OF THE K  40
C     SAME SUBPROGRAM.                                                  K  50
C     TOWSOLV WILL SOLVE FOR ANS GIVEN THE DESIRED FUNCTION VALUE VAR,  K  60
C     THE FUNCTION FUNCT AND THE N AUXILIARY VARIABLES WHICH ARE KNOWN. K  70
C     TOL(1)=ABSOLUTE ERROR.   TOL(2)=RELATIVE ERROR.                   K  80
C                                                                       K  90
      DIMENSION AUXVAR(1), TOL(1)                                       K 100
      ISOLN=1                                                           K 110
      X1=TRY1                                                           K 120
```

(Continued)

Table C-4 (cont'd)

```
      X2=TRY2
      ICOUNT=0
      DENOM=VAR+1.0E-10
      Y1=VAR-FUNCT(AUXVAR,X1)
      IF (X2.EQ.X1) X2=1.03*X1
  109 Y2=VAR-FUNCT(AUXVAR,X2)
      IF (ABS(Y2/DENOM).LE.TOL(2).OR.ABS(Y2).LE.TOL(1)) GO TO 119
      SLOPE=(Y2-Y1)/(X2-X1)
      B=Y2-SLOPE*X2
      X3=-B/SLOPE
      IF (X3.GT.10.0) X3=.5*(10.0-X2)+X2
      X1=X2
      X2=X3
      Y1=Y2
      ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.ITMAX) GO TO 129
      GO TO 109
  119 ANS=X2
      RETURN
  129 ISOLN=0
      RETURN
C
      END
      FUNCTION R(PARM,TRYR,AUXOUT)
C
C     FUNCTION CALCULATES R TO BE USED BY ROOT AND CORF IN DETERMINING
C     THE LMTD CROSSFLOW CORRECTION FACTOR.  SEE BOWMAN,MUELLER, AND
C     NAGLE, 'MEAN TEMPERATURE DIFFERENCE IN DESIGN' TRANS. OF THE ASME.
C
      DIMENSION FACT(20), PARM(2), AUXOUT(1)
      DATA FACT/1.0,2.0,6.0,24.0,120.0,720.0,5040.0,40320.0,362880.0,362
     18800.0,39916800.0,479001600.0,6227020800.0,87178291200.0,1.3076743
     2268E+12,2.0922789888E+13,3.55687428096E+14,6.402373705728E+15,1.216
     3451004088832E+17.2.43290200817664E+18/
```

(Continued)

Table C-4 (cont'd)

```
      P=PARM(1)
      Q=PARM(2)
      R=0.0
      DO 159 J=0,10
         DO 149 I=0,10
            X=I
            Y=J
            ISAVE=(I+J)/2
            SIGN=-1.0
            IF (ABS(FLOAT(ISAVE)-(X+Y)/2.0).LT.1.0E-6) SIGN=1.0
            UPLUS1=FACT(J+1)
            VPLUS1=FACT(I+1)
            IF (I.EQ.0.OR.J.EQ.0) GO TO 109
            UPLUSV=FACT(I+J)
            UFACT=FACT(J)
            VFACT=FACT(I)
            GO TO 139
  109       IF (I+J.NE.0) GO TO 119
            UPLUSV=1.0
            VFACT=UPLUSV
            UFACT=VFACT
            GO TO 139
  119       UPLUSV=FACT(I+J)
            IF (I.EQ.0) GO TO 129
            UFACT=1.0
            VFACT=FACT(I)
            GO TO 139
  129       VFACT=1.0
            UFACT=FACT(J)
  139       CONTINUE
            TERM=(UPLUSV*(P/TRYR)**J*(Q/TRYR)**I)/(UFACT*UPLUS1*VFACT*VP
     1      LUS1)
            R=R+SIGN*TERM
            IF (ABS(TERM/R).GT..00001) GO TO 149
            IF (I.EQ.1) RETURN
            GO TO 159
```

(Continued)

Table C-4 (cont'd)

```
  149    CONTINUE
  159 CONTINUE
      IF (ABS(TERM/R).GT..001) WRITE (6,169)
      RETURN
C
  169 FORMAT (//,1X,36H---CONVERGENCE IN INFINITE SERIES IN,1X,30H SUBPR
     1OGRAM R WAS NOT REALIZED,/,1X,9HEXECUTION,1X,33H WAS NOT TERMINATE
     2D BUT BE AWARE!,//)
C
      END
      SUBROUTINE WATPRO (T,XMU,XK,CP,PR,RHO)
C
C     WATPRO CALCULATES SEVERAL WATER PROPERTIES OF INTEREST GIVEN THE
C     TEMPERATURE (DEG.F)
C     T=TEMPERATURE (DEG.  F)
C     XMU=VISCOSITY (LBM/FT-HR)
C     XK=THERMAL CONDUCTIVITY (BTU/HR-FT**2-DEG.F)
C     CP=SPECIFIC HEAT (BTU/LBM-DEG.F)
C     PR=PRANDTL NUMBER
C     RHO=MASS DENSITY (LBM/FT**3)
C
      DIMENSION TEMTAB(10), XMUTAB(10), XKTAB(10), CPTAB(10), PRTAB(10),
     1 RHOTAB(10)
      DATA TEMTAB/32.0,40.0,60.0,80.0,100.0,120.0,140.0,160.0,180.0,200.
     10/
      DATA CPTAB/1.009,1.005,1.000,.998,.997,.997,.998,1.000,1.002,1.004
     1/
      DATA RHOTAB/62.42,62.42,62.38,62.228,61.996,61.73,61.39,61.01,60.5
     17,60.13/
      DATA XMUTAB/4.33,3.75,2.71,2.08,1.65,1.36,1.14,.97,.84,.74/
      DATA XKTAB/.327,.332,.344,.355,.364,.372,.378,.387,.389,.392/
      DATA PRTAB/13.37,11.35,7.88,5.85,4.53,3.64,3.01,2.53,2.16,1.90/
      XMU=SINTRP(TEMTAB,XMUTAB,T,10)
      XK=SINTRP(TEMTAB,XKTAB,T,10)
```

(Continued)

Table C-4 (cont'd)

```
      CP=SINTRP(TEMTAB,CPTAB,T,10)                                      M 250
      PR=SINTRP(TEMTAB,PRTAB,T,10)                                      M 260
      RHO=SINTRP(TEMTAB,RHOTAB,T,10)                                    M 270
      RETURN                                                            M 280
C                                                                       M 290
      END                                                               M 300
      FUNCTION CORF(TWI,TWO,TAI,TAO)                                    N  10
C                                                                       N  20
C     FUNCTION CORF CALCULATES THE CORRECTION TO THE LMTD DUE TO        N  30
C     CROSS FLOW EFFECTS.                                               N  40
C     CORF CALLS ROOT AND ROOT CALLS R.                                 N  50
C     TWI=AVERAGE INLET WATER TEMPERATURE (DEG.F)                       N  60
C     TWO=AVERAGE OUTLET WATER TEMPERATURE (DEG.F)                      N  70
C     TAI=AVERAGE INLET AIR TEMPERATURE (DEG.F)                         N  80
C     TAO=AVERAGE OUTLET AIR TEMPERATURE (DEG.F)                        N  90
C                                                                       N 100
      DIMENSION TOL(2), PARM(2), AUXOUT(1)                              N 110
      DATA TOL/.001,.001/                                               N 120
      EXTERNAL R                                                        N 130
      P=(TWI-TWO)/(TWI-TAI)                                             N 140
      Q=(TAO-TAI)/(TWI-TAI)                                             N 150
      IF (ABS(P-Q).LT.1.0E-10) GO TO 109                                N 160
      RCF=(P-Q)/ALOG((1.0-Q)/(1.0-P))                                   N 170
      GO TO 119                                                         N 180
  109 RCF=(TWO-TAI)/(TWI-TAI)                                           N 190
  119 CONTINUE                                                          N 200
      PARM(1)=P                                                         N 210
      PARM(2)=Q                                                         N 220
      CALL ROOT (R,PARM,RCF,TOL,RACT,AUXOUT,ISOLN)                      N 230
      CORF=RACT/RCF                                                     N 240
      RETURN                                                            N 250
C                                                                       N 260
      END                                                               N 270
```

(Continued)

Table C-4 (cont'd)

```
      SUBROUTINE ROOT (FUNCT,PARM,TRYX,TOL,ANS,AUXOUT,ISOLN)
C
C     ROOT SOLVES FOR THE ROOT OF X-F(PARM,X,AUXOUT=0.
C     FUNCT=FUNCTION F
C     PARM=ANY PARAMETERS NEEDED TO EVALUATE F
C     TRYX=ESTIMATE OF X
C     TOL(1)=ABSOLUTE CONVERGENCE ERROR IN X
C     TOL(2)=RELATIVE CONVERGENCE ERROR IN X
C     ROOT IS DETERMINED WHEN TOL() OR TOL(2) IS SATUSFIED.
C     FUNCTION MUST BE SET UP LIKE FUNCT(PARM,X,AUXU)
C     AUXOUT=AUXILIARY OUTPUT FROM FUNCT
C
      DIMENSION PARM(1), TOL(2), AUXCUT(1), Y(15), X(15), FUN(15)
      COMMON /PCONTRL/ ITPRINT
      SMALL=1.0E-10
      MAX=15
      ISOLN=0
      IMIN=0
      IMAX=IMIN
      YPLUS=1.0E+30
      YMINUS=-YPLUS
      IF (TRYX.EQ.0.0) TRYX=1.0E-6
      X1=TRYX
      X2=1.15*X1
      ICOUNT=1
      Y1=X1-FUNCT(PARM,X1,AUXOUT)
  109 FUN(ICOUNT)=FUNCT(PARM,X2,AUXOUT)
      X(ICOUNT)=X2
      Y(ICOUNT)=X2-FUN(ICOUNT)
      Y2=Y(ICOUNT)
      IF (ABS(Y2).LT.TOL(1).OR.ABS(Y2/(X2+SMALL)).LT.TOL(2)) GO TO 159
      IF (Y2.LT.0.0) GO TO 119
      IF (Y2.EQ.0.0) RETURN
      IF (Y2.GT.YPLUS) GO TO 129
      IMAX=1
```

(Continued)

Table C-4 (cont'd)

```
      XMAX=X2
      YPLUS=Y2
      GO TO 129
  119 IF (Y2.LT.YMINUS) GO TO 129
      IMIN=1
      XMIN=X2
      YMINUS=Y2
  129 CONTINUE
      SLOPE=(Y2-Y1)/(X2-X1)
      B=Y2-SLOPE*X2
      X3=-B/SLOPE

      X1=X2
      X2=X3
      Y1=Y2
      IF (IMIN.EQ.0) GO TO 139
      IF (X2.LT.XMIN) X2=(X1+XMIN)/2.0
  139 IF (IMAX.EQ.0) GO TO 149
      IF (X2.GT.XMAX) X2=(X1+XMAX)/2.0
  149 CONTINUE
      IF (X2.EQ.X1) X2=X2+1.0E-25

      IF (ICOUNT.GT.MAX) GO TO 169
      IF (ITPRINT.EQ.1) WRITE (6,189) Y(ICOUNT),X(ICOUNT),FUN(ICOUNT)
      ICOUNT=ICOUNT+1
      GO TO 109
  159 ANS=X2
      ISOLN=1
      RETURN
  169 IF (ITPRINT.EQ.1) WRITE (6,179) MAX,TOL,PARM,(Y(I),X(I),FUN(I),I=1
     1,MAX)
      ISOLN=0
      ANS=X2
      RETURN
C
```

(Continued)

Table C-4 (cont'd)

```
  179 FORMAT (1X,15HMAX ITERATIONS=,I3,3HTOL,/,1X,2E11.4,/,1X,7HPARM(1),
     1/,1X,E11.4,//1X,10H---ROOT---,/1X,5HERROR,5X,8HARGUMENT,2X,14HFUNC
     2TION VALUE,/,1X,(3E11.4))
  189 FORMAT (1X,40H---ROOT---/ERROR/ARGUMENT/FUNCTION VALUE,3E10.3)
C
      END
      SUBROUTINE SECANN (FUNCT,AUXVAR,TRY1,TRY2,VAR,ANS,TOL,ISOLN,ITMAX)
C
C     SECANN WILL SOLVE FOR ANS GIVEN THE DESIRED FUNCTION VALUE VAR,
C     THE FUNCTION FUNCT AND THE N AUXILIARY VARIABLES WHICH ARE KNOWN.
C     TOL(1)=ABSOLUTE ERROR.   TOL(2)=RELATIVE ERROR.
C
      DIMENSION AUXVAR(1), TOL(1)
      ISOLN=1
      X1=TRY1
      X2=TRY2
      ICOUNT=0
      DENOM=VAR+1.0E-10
      Y1=VAR-FUNCT(AUXVAR,X1)
      IF (X2.EQ.X1) X2=1.03*X1
  109 Y2=VAR-FUNCT(AUXVAR,X2)
      IF (ABS(Y2/DENOM).LE.TOL(2).OR.ABS(Y2).LE.TOL(1)) GO TO 119
      SLOPE=(Y2-Y1)/(X2-X1)
      B=Y2-SLOPE*X2
      X3=-B/SLOPE
      X1=X2
      X2=X3
      Y1=Y2
      ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.ITMAX) GO TO 129
      GO TO 109
  119 ANS=X2
```

(Continued)

Table C-4 (cont'd)

```
      RETURN
  129 ISOLN=0
      RETURN
C
      END
      FUNCTION RHOAIR(OMEGA,TDB,P)
C
C     RHOAIR WILL CALCULATE THE MOIST AIR DENSITY GIVEN THE SPECIFIC
C     HUMIDITY (LBM WATER/LBM DRY AIR), DRY BULB TEMPERATURE (DEG.F),
C     AND STATIC PRESSURE (PSIA).
C
      R=1545.0/(144.0*28.9)
      RHO=P/(R*(460.0+TDB))
      RHOAIR=RHO*(1.0+OMEGA)
      RETURN
C
      END
      FUNCTION WBDEW(TDB,PT,DEWPT,TOL)
C
C     FUNCTION WBDEW CALCULATES THE WET BULB TEMPERATURE (DEG.F)
C     GIVEN THE DRY BULB TEMPERATURE (DEG.F), DEWPOINT (DEG.F), STATIC
C     PRESSURE (PSIA) AND TWO TOLERANCES.
C
      DIMENSION TOL(2)
      W=SATHUM(DEWPT,PT)
      WBDEW=TWB(TDB,PT,W,TOL)
      RETURN
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      FUNCTION TOFLO(VSTACK,NSTACK,ASTACK,VHTX,NHTX,AHTX,TSTACK,PT,THTX,
     1PERDIF)
C
C     TOFLO CALCULATES THE TOTAL DRY AIR FLOW THROUGH THE TOWER. NOTE
C     THAT FOR THE CELL FLOW RATE THE TOTAL FLOW MUST BE DIVIDED BY TWO.
C     VSTACK=ARRAY OF STACK VELOCITIES, WITH NSTACK ELEMENTS.
C     ASTACK=STACK AREA NORMAL TO AIR FLOW.
C     VHTX=ARRAY OF HEAT EXCHANGER FACE VELOCITIES WITH NHTX ELEMENTS.
C     AHTX=HEAT EXCHANGER FACE AREA.
C     WSTACK,WHTX=STACK AND HEAT EXCHANGER SPECIFIC HUMIDITY.
C     TSTACK,THTX=STACK AND HEAT EXCHANGER INLET AIR TEMPERATURE.
C     PERDIF=PERCENT DIFFERENCE BETWEEN MASS FLOW RATES AS MEASURED
C     AT STACK AND HEAT EXCHANGER FACE.
C
      DIMENSION VSTACK(NSTACK), VHTX(NHTX)
      SUM=0.0
      J=0
      DO 119 I=1,NSTACK
         IF (VSTACK(I).LE.0.0) GO TO 109
         SUM=SUM+VSTACK(I)
         J=J+1
  109    CONTINUE
  119 CONTINUE
      IF (J.LT.1) J=1
      VSAV=SUM/FLOAT(J)
      SUM=0.0
      J=0
      DO 139 I=1.NHTX
         IF (VHTX(I).LE.0.0) GO TO 129
         SUM=SUM+VHTX(I)
         J=J+1
  129    CONTINUE
```

(Continued)

Table C-4 (cont'd)

```
  139 CONTINUE
      IF (J.LT.1) J=1
      VHTXAV=SUM/FLOAT(J)
      T=TSTACK+460.0
      DENDRY=PT/((1545.0/(29.0*144.0))*T)
      TOFLO=ASTACK*DENDRY*VSAV*3600.0
      DENDRY=DENDRY*(T/(460.0+THTX))
      HTXFLO=DENDRY*AHTX*VHTXAV*3600.0*2.0
      PERDIF=(HTXFLO-TOFLO)*100.0/TOFLO
      RETURN
C
      END
      SUBROUTINE VEL (VP,N,TDP,PT,T)
C
C     VEL REDEFINES ARRAY VP WITH N ELEMENTS FROM A VEL PRESSURE IN
C     INCHES OF WATER COLUMN TO A VELOCITY IN FT/SEC.
C
      DIMENSION VP(N)
C
C     TDP=DEW POINT.
C     PT=AMBIENT PRESSURE.
C     T=TEMPERATURE.
C
      W=SATHUM(TDP,PT)
      RHO=RHOAIR(W,T,PT)
      DO 109 I=1,N
  109 VP(I)=SQRT(2.0*VP(I)*5.204*32.174/RHO)
      RETURN
C
      END
      FUNCTION CONVERT(VP,ITYPE)
C
C     FUNCTION CONVERTS VELOCITY PRESSURE AS FOUND ON DATA TAPES TO
C     INCHES OF WATER COLUMN.  ALSO CHECKS FOR NEGATIVE PRESSURES.
```

(Continued)

Table C-4 (cont'd)

```
C
      IF (VP.LT.0.0) VP=0.0
C
C     ITYPE=1 IF VELOCITY PRESSURE IS FROM HEAT EXCHANGER FAN.
C     ITYPE=2 IF VELOCITY PRESSURE IS FROM STACK.
C
      GO TO (109,119), ITYPE
  109 CONTINUE
C
C     HEAT EXCHANGER FAN
C
      CONVERT=(VP*.01/760.0)*33.9*12.0
      RETURN
  119 CONTINUE
C
C     STACK
C
      CONVERT=(VP*.1/760.0)*33.9*12.0
      RETURN
C
      END
      SUBROUTINE DEWCON (DP,N)
C
C     SUBROUTINE WILL CONVERT THE ARRAY DP(I), WITH N ELEMENTS, FROM
C     A DEWCELL TEMPERATURE TO THE CORRESPONDING DEWPOINT TEMPERATURE.
C     NOTE THAT ARRAY DP IS DESTROYED AND REDEFINED.
C
      DIMENSION DP(N), DCTAB(24), DPTAB(24)
      DATA IFIRST/0/
      DATA DPTAB/1.7,8.3,15.0,21.7,28.3,35.5,43.2,50.5,57.4,64.2,71.0,77
     1.8,84.3,90.4,96.2,103.0,110.6,118.5,126.6,134.5,142.2,149.8,157.4,
     2165.1/
      IF (IFIRST.NE.0) GO TO 119
      DCTAB(1)=50.0
```

(Continued)

Table C-4 (cont'd)

```
      DO 109 I=2,24                                                     V 140
  109 DCTAB(I)=DCTAB(I-1)+10.0                                          V 150
      IFIRST=1                                                          V 160
  119 CONTINUE                                                          V 170
      DO 129 I=1,N                                                      V 180
         IF (DP(I).GE.997.0) GO TO 129                                  V 190
         IF (DP(I).GT.280.0.OR.DP(I).LT.50.0) GO TO 139                 V 200
         DP(I)=SINTRP(DCTAB,DPTAB,DP(I),24)                             V 210
  129 CONTINUE                                                          V 220
      RETURN                                                            V 230
  139 WRITE (6,149)                                                     V 240
      CALL EXIT                                                         V 250
C                                                                       V 260
  149 FORMAT (/1X,41H---DEWCELL TEMPERATURE IS OUT OF RANGE OF,1X,20HSUB V 270
     1ROUTINE DEWCON---,)                                               V 280
C                                                                       V 290
      END                                                               V 300
      FUNCTION WATDIST(HI,XLO,SG,T,HTXL,TFLUID,ITRAND,VHTX,VZERO,PERDIF) W  10
C                                                                       W  20
C     FUNCTION CALCULATES THE WATER FLOW TO THE DRY PORTION OF          W  30
C     THE TOWER.  THE FUNCTION USES A LEAST                             W  40
C     SQUARES POLYNOMIAL APPROXIMATION.                                 W  50
C     T=MANOMETER AMBIENT TEMPERATURE(DEG F)                            W  60
C     TFLUID=METERED FLUID TEMPERATURE(DEG. F)                          W  70
C     ITRAND=1 IF WANT TRANSDUCER FLOWRATE TO BE USED.                  W  80
C     ITRAND=0 IF WANT MANOMETER FLOWRATE TO BE USED                    W  90
C     VHTX=TRANSDUCER VOLTAGE(MV).                                      W 100
C     VZERO=TRANSDUCER VOLTAGE AT ZERO PRESSURE DIFFERENCE(MV).         W 110
C     PERDIF=DIFFERENCE IN PERCENT BETWEEN MANOMETER                    W 120
C     AND TRANSDUCER FLOWRATE                                           W 130
C                                                                       W 140
      DIMENSION HRHO(12), QTAB(12), TTAB(3), SPTAB(3), A(3), B(3)       W 150
      DATA TTAB/110.0,70.0,40.0/                                        W 160
      DATA SPTAB/2.911,2.96,2.9965/                                     W 170
      DATA HRHO/1.40386,1.154789,.826735,.7160475,.690416,.490664,.40184 W 180
```

(Continued)

Table C-4 (cont'd)

```
     1,.342447,.272879,.193039,.157909,0.0/
      DATA QTAB/12000.0,10800.0,9000.0,8400.0,8100.0,6300.0,6000.0,5400.
     10,4500.0,4200.0,3000.0,0.0/
      DATA A/6.5291E+2,3.8154E+8,-3.0978E+12/
      DATA B/1.0934E+3,1.3139E+4,-3.9565E+3/
      NUMPTS=12
      IF (ABS(SG-2.95).GT.1.0E-3) GO TO 119
      SPGR=SINTRP(TTAB,SPTAB,T,3)
      RHOSTD=62.42
      CALL WATPRO (T,G,G,G,G,RHO)
      CALL WATPRO (TFLUID,G,G,G,G,RHOF)
      SPGF=RHOF/RHOSTD
      SPGWAT=RHO/RHOSTD
      H1=(HI+XLO)*(SPGR-SPGWAT)
      H2=12.0*HTXL*(SPGF-SPGWAT)
      H=H1+H2
      HINTER=H/RHOF
      GPM=B(1)+B(2)*HINTER+B(3)*HINTER**2
      WATDIST=GPM
      VZ=(VHTX-VZERO)/RHOF
      GPM1=A(1)+A(2)*VZ+A(3)*VZ**2
      IF (ABS(HI+XLO).LE.1.0E-3.OR.ITRAND.EQ.1) WATDIST=GPM1
      IF (ABS(HI+XLO).LE.1.0E-3) GO TO 109
      PERDIF=(GPM-GPM1)*100.0/GPM
      RETURN
  109 CONTINUE
      PERDIF=100.0
      RETURN
  119 WRITE (6,129)
      CALL EXIT
      RETURN
C
  129 FORMAT (1X,40(1H-),35HSOMEONE CHANGED THE MANOMETER FLUID,1X,51HSP
     1ECIFIC GRAVITY USED TO MEASURE DRY TOWER FLOWRATE)
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      FUNCTION ANUBAR(PERFF,HI,XLO,SPGR,TI,TMETER,PERDIF,ITRAN)
C
C     ANUBAR CALCULATES THE WATER FLOW RATE IN GPM GIVEN:
C     PERFF-PERCENT OF FULL FLOW AS INDICATED BY A PRESSURE TRANSDUCER-
C     THIS IS USED AS A CHECK ON THE MANOMETER.
C     HI-HIGH PRESSURE MANOMETER READING (IN).
C     XLO-LOW PRESSURE MANOMETER HEADING (IN)
C     SPGR-SPECIFIC GRAVITY OF MANOMETER FLUID RELATIVE TO
C     WATER AT 4 DEG C.
C     TI-INSTRUMENT TEMPERATURE(DEG. F)
C     TMETER-METERED FLUID TMEPERATURE(DEG. F)
C     ITRAN-IF=1 THEN TRANSDUCER FLOWRATE IS PASSED ON AS FLOWRATE.
C     IF=0 THEN MANOMETER FLOWRATE IS PASSED ON
C     OUTPUT:
C     PERDIF-THE PERCENT DIFFERENCE IN FLOW RATE AS INDICATED BY THE
C     PRESSURE TRANSDUCER AND THE MANOMETER.
C
      DIMENSION SPTAB(3), TTAB(3)
      DATA SPTAB/2.911,2.96,2.9965/
      DATA TTAB/110.0,70.0,40.0/
      IF (ABS(SPGR-2.95).GT.1.0E-3) GO TO 109
      FULLSC=25468.0
      RHOSTD=62.42
      S=.7364
      XN=29.84
      D2=862.95
      GL=1.0
      CALL WATPRO (90.0,GARB,BARB,GARB,GARB,RHONOR)
      CALL WATPRO (TMETER,GARB,GARB,GARB,GARB,RHO)
      SPGRW=RHO/RHOSTD
      HN=(62.42/1728.0)*(SINTRP(TTAB,SPTAB,TI,3)-SPGRW)*(HI+XLO)
      SPGRW=RHO/62.383
      ANUBAR=S*XN*D2*SQRT(SPGRW*HN)/(GL*2.0)
```

(Continued)

Table C-4 (cont'd)

```
      TRANS=FULLSC*SQRT(RHO/RHONOR)*SQRT(PERFF/100.0)/2.0
      PERDIF=(TRANS-ANUBAR)*100.0/ANUBAR
      IF (ANUBAR.LE.1.0) PERDIF=100.0
      IF (ITRAN.EQ.1.OR.ABS(HI+XLO).LE.1.0E-3) ANUBAR=TRANS
      RETURN
  109 WRITE (6,119)
      CALL EXIT
C
  119 FORMAT (1X,40(1H-),34HSOMEONE CHANGED THE FLUID SPECIFIC,/1X,45HGR
     1AVITY USED TO MEASURE TOWER  WATER FLOWRATE,40(1H-))
C
      END
      FUNCTION AIRH(W,PT,T)
C
C     AIRH CALCULATES THE MOIST AIR SPECIFIC ENTHALPY (BTU/LBM DRY
C     AIR) GIVEN THE SPECIFIC HUMIDITY W (DIMENSIONLESS), MIXTURE
C     STATIC PRESSURE PT(PSIA), AND TEMPERATURE T(DEG.F)
C
      COMMON /PCONTRL/ ITPRINT
      PV=W*PT/(.622+W)
      HV=ENTHLP(PV,T)
      CALL AIRPRO (T,G,G,CP,G)
      AIRH=CP*T+W*HV
      IF (ITPRINT.NE.1) RETURN
      WRITE (6,109) W,PT,T,AIRH
      RETURN
C
  109 FORMAT (1X,23H--- AIRH---INPUT-W/PT/T,4F11.4/1X,11HOUTPUT-AIRH,3E1
     11.4)
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      SUBROUTINE CODE (ICODE,IDATE,IPUN)
      DIMENSION ICODE(6), TEST(9), SEAS(4)
      DATA TEST/3HWET,7HWET/DRY,3HDRY,9HFILL TEST,8HFAN TEST,10HPLUME TE
     1ST,8HACOUSTIC,10HAIR TRAVEL,4HTEST/
      DATA SEAS/6HWINTER,6HSPRING,6HSUMMER,4HFALL/
      WRITE (6,289)
      WRITE (6,189)
      WRITE (6,299) IDATE
      MM=ICODE(1)
      GO TO (109,119,129,139,149,159,169), MM
  109 WRITE (6,199) TEST(1),TEST(4)
      GO TO 179
  119 WRITE (6,209) TEST(2),TEST(4)
      GO TO 179
  129 WRITE (6,219) TEST(3),TEST(4)
      GO TO 179
  139 WRITE (6,229) TEST(5)
      GO TO 179
  149 WRITE (6,239) TEST(6)
      GO TO 179
  159 WRITE (6,249) TEST(7),TEST(9)
      GO TO 179
  169 WRITE (6,259) TEST(8),TEST(9)
  179 CONTINUE
      J=ICODE(2)
      WRITE (6,269) SEAS(J)
      WRITE (6,279) (ICODE(I),I=3,6)
      RETURN
C
  189 FORMAT (1X,120(1H-),/,1X,40(1H-),30HTVA COOLING TOWER TEST RESULTS
     1,50(1H-),/,1X,120(1H-),//)
  199 FORMAT (1X,40X,A3,1X,A9)
  209 FORMAT (1X,40X,A7,1X,A9)
  219 FORMAT (1X,40X,A3,1X,A9)
```

(Continued)

Table C-4 (cont'd)

```
  229 FORMAT (1X,40X,A8)
  239 FORMAT (1X,40X,A10)
  249 FORMAT (1X,40X,A8,1X,A4)
  259 FORMAT (1X,40X,A10,1X,A4)
  269 FORMAT (1X,40X,A6)
  279 FORMAT (1X,40X,17HTEST BLOCK NUMBER,1X,I2/1X,40X,11HTEST NUMBER,1X
     1,2I1/1X,40X,6HNUMBER,1X,I2,1X,6HREPEAT,////)
  289 FORMAT (1H1)
  299 FORMAT (1X,40X,4HDATE,1X,I3)
C
      END
      FUNCTION DEWINT(GARB,T)
C
C     DEWINT IS AN INTERMEDIATE SUBPROGRAM WHICH ALLOWS FUNCTION T
C     TO USE SUBROUTINE SECANN BY FORMATING THE FUNCTION STATEMENT
C     CORRECTLY
C
      DIMENSION GARB(1)
      DEWINT=PV(T)
      RETURN
C
      END
      FUNCTION TSATV(PV)
C
C     T CALCULATES THE DEWPOINT (OR SATURATION TEMPERATURE) OF AN
C     AIR-WATER VAPOR MIXTURE GIVEN THE PARTIAL PRESSURE OF THE
C     WATER VAPOR
C
      DIMENSION TOL(2), AUXVAR(1)
      EXTERNAL DEWINT
      TOL(1)=.00005
      TOL(2)=.0005
      IT=15
      CALL SECANN (DEWINT,AUXVAR,40.0,110.0,PV,TSATV,TOL,I,IT)
```

(Continued)

Table C-4 (cont'd)

```
      IF (I.EQ.0) GO TO 109
      RETURN
  109 WRITE (6,119)
C
  119 FORMAT (1X,10(1H-),34HNO SOLUTION RETURNED TO FUNCTION T,10(1H-),/
     1,1X,3HPV=,E10.3//)
C
      END
      FUNCTION SPHUM(T,TWB,PT)
C
C     SPHUM CALCULATES THE SPECIFIC HUMIDITY GIVEN:
C     T-DRY BULB TEMPERATURE(DEG. F)
C     TWB-WET BULB TEMPERATURE(DEG. F)
C     PT-ATMOSPHERIC PRESSURE(PSIA)
C
      CALL AIRPRO ((T+TWB)/2.0,G,G,CP,G)
      Q=TWB
      IF (Q.GT.T) Q=T
      SPHUM=(CP*(Q-T)+SATHUM(T,PT)*(HV(Q)-HF(Q)))/(HV(T)-HF(Q))
      RETURN
C
      END
      FUNCTION RELHUM(OMEGA,PT,T)
C
C     RELHUM CALCULATES THE RELATIVE HUMIDITY FROM THE SPECIFIC
C     HUMIDITY(LBM H2O/LBM DRY AIR),MIXTURE PRESSURE(PSIA),
C     AND DRYBULB(DEG. F)
C
      PG=OMEGA*PT/(.62198+OMEGA)
      PVAP=PV(T)
      RELHUM=PG*100.0/PVAP
      RETURN
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      SUBROUTINE REDUC (NX,IFLAG,IPUN)
      DIMENSION INPUT(129,5), P2(10,5), A(28), B(8), MONTH(12), NMO(12)
      DIMENSION IDENT(118), X(118), XCAL2(5), INPAR(6,5), PLUM(52)
      COMMON /DAT2/ ELEV(8,5),DBP(8,5),WBDP(8,5),AVELP(8,5),VISIO(5),NCT
     12(5)
      COMMON /DATIN/ X,VPHTX(9),CAL1,VPSTK(10),CAL2,NPAR(6),NRUN
      DATA (IDENT(I),I=1,118)/16,12,21,24,17,20,23,13,19,11,30,26,29,32,
     125,28,31,14,27,15,45,76,47,48,49,69,70,71,54,55,56,53,57,108,109,6
     20,46,50,51,52,61,62,63,64,72,73,74,75,65,66,67,68,38,42,41,35,43,4
     30,37,44,39,36,80,84,81,77,85,82,78,86,83,79,90,91,89,92,93,94,95,9
     46,97,98,106,107,58,59,33,34,87,10,18,99,100,101,102,103,104,105,11
     58,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,
     6135,136,137/
      DATA (MONTH(I),I=1,12)/31,28,31,30,31,30,31,31,30,31,30,31/
      DATA (NMO(I),I=1,12)/3HJAN,3HFEB,3HMAR,3HAPR,3HMAY,3HJUN,3HJUL,3HA
     1UG,3HSEP,3HOCT,3HNOV,3HDEC/
      REAL INPUT
      INTEGER T1,T2,T3,ELEV
      DATA BT,OL/1HB,1HO/
      IBL=0
      IF (NX.GT.1) GO TO 329
      IFLAG=0
      READ (5,399)
      DO 309 J=1,5
         READ (5,399) INRUN,T1,T2,T3
         IF (J.EQ.1) NRUN=INRUN
         IF (EOF(5)) 379,109
109      IF (J.GT.1) GO TO 139
         IDATE=NRUN
         IF (IDATE.GT.365) GO TO 129
         DO 119 I=1,12
            KK=I
            IF (IDATE.LE.MONTH(I)) GO TO 139
119      IDATE=IDATE-MONTH(I)
```

(Continued)

Table C-4 (cont'd)

```
129     WRITE (6,499)                                                         AE  350
139     READ (5,479) (INPAR(I,J),I=1,6)                                       AE  360
        WRITE (6,489) (INPAR(I,J),I=1,6),NMO(KK),IDATE                        AE  370
        IF (IPUN.EQ.1) WRITE (7,489) (INPAR(I,J),I=1,6),NMO(KK),IDATE         AE  380
        READ (5,419) XCAL2(J)                                                 AE  390
        DO 159 I=1,10                                                         AE  400
           DO 149 N=1,2                                                       AE  410
149        READ (5,399)                                                       AE  420
159     READ (5,419) P2(I,J)                                                  AE  430
        DO 169 N=1,2                                                          AE  440
169     READ (5,399)                                                          AE  450
        IB=1                                                                  AE  460
        IE=4                                                                  AE  470
        DO 199 I=1,27                                                         AE  480
           READ (5,429) A                                                     AE  490
           DO 189 I2=1,28                                                     AE  500
              IF (A(I2).NE.BT) GO TO 179                                      AE  510
              A(I2)=1H9                                                       AE  520
              A(I2+1)=1H9                                                     AE  530
              A(I2+2)=1H9                                                     AE  540
              GO TO 189                                                       AE  550
179           IF (A(I2).NE.OL) GO TO 189                                      AE  560
              A(I2)=1H9                                                       AE  570
              A(I2+1)=1H9                                                     AE  580
              A(I2+2)=1H8                                                     AE  590
189        CONTINUE                                                           AE  600
           ENCODE (60,429,B) A                                                AE  610
           DECODE (60,439,B) (INPUT(I3,J),I3=IB,IE)                           AE  620
           IB=IE+1                                                            AE  630
199     IE=IE+4                                                               AE  640
        DO 229 IX=1,2                                                         AE  650
           DO 209 I=1,3                                                       AE  660
209        READ (5,399)                                                       AE  670
           SUM=0.0                                                            AE  680
           DO 219 I=1,5                                                       AE  690
```

(Continued)

Table C-4 (cont'd)

```
         READ (5,439) X1,X2,X3,X4                                       AE  700
  219       SUM=SUM+X1+X2+X3+X4                                         AE  710
            IX2=IX+108                                                  AE  720
  229    INPUT(IX2,J)=SUM/20.                                           AE  730
         DO 239 I=111,128                                               AE  740
            CALL RI (NDUM)                                              AE  750
  239    CALL RR (INPUT(I,J))                                           AE  760
         IF (J.EQ.5) IFLAG=5                                            AE  770
         IF (INPAR(1,J).NE.5) GO TO 309                                 AE  780
         DO 249 I=1,4                                                   AE  790
  249    READ (5,399)                                                   AE  800
         READ (5,509) (PLUM(I),I=1,52)                                  AE  810
         WRITE (6,539) (PLUM(I),I=1,52)                                 AE  820
         IF (IPUN.EQ.1) WRITE (7,539) (PLUM(I),I=1,52)                  AE  830
         SUM=0.0                                                        AE  840
         DO 259 JX=1,52                                                 AE  850
            SUM=SUM+PLUM(JX)                                            AE  860
  259    CONTINUE                                                       AE  870
         VISIO(J)=SUM/52.                                               AE  880
         NCT=0                                                          AE  890
  269    READ (5,519) ICH                                               AE  900
         IF (EOF(5)) 389,279                                            AE  910
  279    IF (ICH.EQ.IBL) GO TO 299                                      AE  920
         SUM1=0.0                                                       AE  930
         SUM2=0.0                                                       AE  940
         SUM3=0.0                                                       AE  950
         NCT=NCT+1                                                      AE  960
         ELEV(NCT,J)=ICH                                                AE  970
         WRITE (6,529) ICH                                              AE  980
         IF (IPUN.EQ.1) WRITE (7,529) ICH                               AE  990
         DO 289 JX=1,4                                                  AE 1000
            READ (5,549) A1,B1,C,D,E,F,G,H,P                            AE 1010
            WRITE (6,539) A1,B1,C,D,E,F,G,H,P                           AE 1020
            IF (IPUN.EQ.1) WRITE (7,539) A1,B1,C,D,E,F,G,H,P            AE 1030
            SUM1=SUM1+B1                                                AE 1040
```

(Continued)

Table C-4 (cont'd)

```
            SUM2=SUM2+D                                    AE 1050
            SUM3=SUM3+H                                    AE 1060
 289      CONTINUE                                         AE 1070
          DBP(NCT,J)=SUM1/4.                               AE 1080
          WBDP(NCT,J)=SUM2/4.                              AE 1090
          AVELP(NCT,J)=SUM3/4.                             AE 1100
          READ (5,399)                                     AE 1110
          GO TO 269                                        AE 1120
 299      NCT2(J)=NCT                                      AE 1130
 309  CONTINUE                                             AE 1140
 319  WRITE (6,459)                                        AE 1150
 329  DO 339 I=1,118                                       AE 1160
        IPOS=IDENT(I)-9                                    AE 1170
 339  X(I)=INPUT(IPOS,NX)                                  AE 1180
      DO 349 I=1,6                                         AE 1190
 349  NPAR(I)=INPAR(I,NX)                                  AE 1200
      DO 359 I=1,10                                        AE 1210
 359  VPSTK(I)=P2(I,NX)                                    AE 1220
      CAL2=XCAL2(NX)                                       AE 1230
      DO 369 I=1,9                                         AE 1240
 369  VPHTX(I)=0.0                                         AE 1250
      CAL1=0.0                                             AE 1260
      WRITE (6,409) NRUN,NPAR                              AE 1270
      WRITE (6,449) (X(I),I=1,139)                         AE 1280
      WRITE (6,449) (INPUT(I,NX),I=101,109)                AE 1290
      WRITE (6,459)                                        AE 1300
      IF (IPUN.NE.1) RETURN                                AE 1310
      WRITE (7,409) NRUN,NPAR                              AE 1320
      WRITE (7,469) (X(I),I=1,139)                         AE 1330
      WRITE (7,469) (INPUT(I,NX),I=101,109)                AE 1340
      RETURN                                               AE 1350
 379  IFLAG=J-1                                            AE 1360
      IF (J.GT.1) GO TO 319                                AE 1370
      RETURN                                               AE 1380
 389  IFLAG=J                                              AE 1390
```

(Continued)

Table C-4 (cont'd)

```
      IF (J.GT.1) GO TO 319                                             AE 1400
      RETURN                                                            AE 1410
C                                                                       AE 1420
  399 FORMAT (I3,3(1X,I2))                                              AE 1430
  409 FORMAT (2X,I3,3X,6I1)                                             AE 1440
  419 FORMAT (4X,F7.3)                                                  AE 1450
  429 FORMAT (4(4X,7A1,4X))                                             AE 1460
  439 FORMAT (4(4X,F7.2,4X))                                            AE 1470
  449 FORMAT (1X,8E10.2)                                                AE 1480
  459 FORMAT (//)                                                       AE 1490
  469 FORMAT (8E10.2)                                                   AE 1500
  479 FORMAT (2X,6I1)                                                   AE 1510
  489 FORMAT (2X,8H? RUNID ,6I1,3X,A3,1H ,I2,6H, 1978)                  AE 1520
  499 FORMAT (2X,20HTHE DATE IS IN ERROR)                               AE 1530
  509 FORMAT (4X,F8.2,3(7X,F8.2))                                       AE 1540
  519 FORMAT (I3)                                                       AE 1550
  529 FORMAT (1X,I3)                                                    AE 1560
  539 FORMAT (9F8.3)                                                    AE 1570
  549 FORMAT (9F7.2)                                                    AE 1580
C                                                                       AE 1590
      END                                                               AE 1600
      REAL FUNCTION ENTHLP(P,T)                                         AF   10
C                                                                       AF   20
C*****THIS SUBPROGRAM WILL CALCULATE THE ENTHALPY OF                    AF   30
C     SUPERHEATED STEAM                                                 AF   40
C                                                                       AF   50
      COMMON /CONTROL/ IPSMAL,ITPRINT                                   AF   60
      H1=1100.0                                                         AF   70
      IMAX=10                                                           AF   80
      A1=-1.0659659E+4                                                  AF   90
      A2=2.0110905E+1                                                   AF  100
      A3=-1.250954E-2                                                   AF  110
      A4=2.8274992E-6                                                   AF  120
      A5=4.981582                                                       AF  130
      A6=-7.7618225E-6                                                  AF  140
```

(Continued)

Table C-4 (cont'd)

```
      A7=2.4391612E-10
      A8=-9.8147341E-3
      A9=6.582489E-6
      A10=-1.4747938E-9
      Y1=T-A1-A2*H1-A3*H1**2-A4*H1**3-A5*P-A6*P**2-A7*P**3-P*(A8*H1+A9*H
     11**2+A10*H1**3)
      H2=.99*H1
      ICOUNT=0
  109 HSQ=H2**2
      HCUB=H2*HSQ
      PSQ=P**2
      PCUB=PSQ*P
      Y2=T-A1-A2*H2-A3*HSQ-A4*HCUB-A5*P-A6*PSQ-A7*PCUB-P*(A8*H2+A9*HSQ+A
     110*HCUB)
      IF (ABS(Y2).LT..05) GO TO 119
      ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.IMAX) GO TO 129
      SLOPE=(Y2-Y1)/(H2-H1)
      B=Y2-SLOPE*H2
      H3=-B/SLOPE
      Y1=Y2
      Y2=Y3
      H1=H2
      H2=H3
      GO TO 109
  119 ENTHLP=H2
      IF (ITPRINT.EQ.1) PRINT 139, P,T,ENTHLP
      RETURN
  129 PRINT 149
      CALL EXIT
C
  139 FORMAT (1X,2HP=,F7.3,2X,2HT=,F5.1,2X,2HH=,F7.2,21HFROM FUNCTION--E
     1NTHLP)
  149 FORMAT (1X,26HTOO MANY ITERATIONS--ENTHP,///)
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      SUBROUTINE AIRPRO (T,XMU,XK,CP,PR)
C
C     WHERE XMU(LBM/HR-FT),XK(B/HR-FT-DEG.F), CP(B/LBM-DEG.F),
C     PR(PRANDTL NUMBER) ARE A FUNCTION OF T(DEG.F).
C
      DIMENSION TABXMU(8), TABXK(8), TABCP(8), TABPR(8), TABTEM(8)
      DATA TABXMU/.0394,.0427,.0459,.0484,.0519,.0547,.0574,.0626/
      DATA TABXK/.0131,.0143,.0157,.0167,.0181,.0192,.0203,.0225/
      DATA TABCP/.24,.24,.24,.241,.241,.242,.243,.245/
      DATA TABPR/.718,.712,.706,.699,.693,.69,.686,.681/
      DATA TABTEM/0.0,50.0,100.0,150.0,200.0,250.0,300.0,400.0/
      XMU=SINTRP(TABTEM,TABXMU,T,8)
      XK=SINTRP(TABTEM,TABXK,T,8)
      CP=SINTRP(TABTEM,TABCP,T,8)
      PR=SINTRP(TABTEM,TABPR,T,8)
      RETURN
C
      END
      SUBROUTINE BESLI (V,TOL,IO,I1)
      REAL IO,I1
      REO=1.0
      RE1=0.5*V
      IO=REO
      I1=RE1
      P=0.0
      V2=V*V/4.0
      IF (V.LT.15.0) GO TO 119
      REO=1.0/(8.0*V)
      RE1=3.0/(8.0*V)
      IO=1.0+REO
      I1=1.0-RE1
      P=1.0
      P=P+1.0
      REO=REO*(2.0*P-1.0)**2/(P*8.0*V)
```

(Continued)

Table C-4 (cont'd)

```
      IO=IO+REO                                                         AH 170
      IF (REO/IO.GT.TOL) GO TO 109                                      AH 180
      P=1.0                                                             AH 190
  109 P=P+1                                                             AH 200
      RE1=-RE1*(4.0-(2.0*P-1.0)**2)/(P*8.0*V)                           AH 210
      I1=I1+RE1                                                         AH 220
      IF (ABS(RE1/I1).GT.TOL) GO TO 109                                 AH 230
      REO=EXP(V)/SQRT(2.0*V*3.1415926)                                  AH 240
      IO=IO*REO                                                         AH 250
      I1=I1*REO                                                         AH 260
      RETURN                                                            AH 270
  119 P=P+1.0                                                           AH 280
      REO=REO*V2/(P*P)                                                  AH 290
      IO=IO+REO                                                         AH 300
      IF (REO/IO.GT.TOL) GO TO 119                                      AH 310
      P=0.0                                                             AH 320
  129 P=P+1.0                                                           AH 330
      RE1=RE1*V2/(P*(P+1.0))                                            AH 340
      I1=I1+RE1                                                         AH 350
      IF (RE1/I1.GT.TOL) GO TO 129                                      AH 360
      RETURN                                                            AH 370
C                                                                       AH 380
      END                                                               AH 390
      SUBROUTINE BESLK (V,IO,I1,TOL,KO,K1)                              AI  10
      REAL IO,I1,KO,K1                                                  AI  20
      GAM=0.5772156649                                                  AI  30
      KO=-(GAM+ALOG(V/2.0))*IO                                          AI  40
      K1=(GAM+ALOG(V/2.0))*I1+1.0/V                                     AI  50
      EDO=0.5                                                           AI  60
      ED1=0.5*(-V/2.0)                                                  AI  70
      REO=0.0                                                           AI  80
      RE1=1.0                                                           AI  90
      P=0.0                                                             AI 100
      IF (V.LT.8.0) GO TO 129                                           AI 110
      EDO=1.0/(8.0*V)                                                   AI 120
```

(Continued)

Table C-4 (cont'd)

```
      ED1=3.0/(8.0*V)                                         AI  130
      KO=1.0-EDO                                              AI  140
      K1=1.0+ED1                                              AI  150
      P=1.0                                                   AI  160
  109 P=P+1                                                   AI  170
      EDO=-((2.0*P-1.0)**2/(8.0*V*P))*EDO                     AI  180
      KO=KO-EDO                                               AI  190
      IF (ABS(EDO/KO).GT.TOL.AND.P.LT.2.0*V) GO TO 109        AI  200
      P=1.0                                                   AI  210
  119 P=P+1.0                                                 AI  220
      ED1=ED1*(4.0-(2.0*P-1.0)**2)/(8.0*P*V)                  AI  230
      K1=K1+ED1                                               AI  240
      IF (ABS(ED1/K1).GT.TOL.AND.P.GT.2.0*V) GO TO 119        AI  250
      EDO=EXP(-V)*SQRT(3.1415926/(2.0*V))                     AI  260
      KO=KO*EDO                                               AI  270
      K1=K1*EDO                                               AI  280
      RETURN                                                  AI  290
  129 P=P+1.0                                                 AI  300
      EDO=(V*V/4.0)*EDO/(P*P)                                 AI  310
      REO=REO+2.0/P                                           AI  320
      KO=KO+EDO*REO                                           AI  330
      IF (ABS(EDO*REO/KO).GT.TOL) GO TO 129                   AI  340
      K1=K1+RE1*ED1                                           AI  350
      P=0.0                                                   AI  360
  139 P=P+1.0                                                 AI  370
      ED1=V*V*ED1/(P*4.0*(P+1.0))                             AI  380
      RE1=RE1+1.0/P+1.0/(P+1.0)                               AI  390
      K1=K1+ED1*RE1                                           AI  400
      IF (ABS(RE1*ED1/K1).GT.TOL) GO TO 139                   AI  410
      RETURN                                                  AI  420
C                                                             AI  430
      END                                                     AI  440
```

(Continued)

Table C-4 (cont'd)

```
          REAL FUNCTION SINTRP(XT,YT,X,N)                                   AJ  10
          DIMENSION YT(N), XT(N)                                            AJ  20
          NM1=N-1                                                           AJ  30
          K=2                                                               AJ  40
          IF (XT(2).GT.X) GO TO 139                                         AJ  50
          K=NM1                                                             AJ  60
          IF (XT(K).LE.X) GO TO 139                                         AJ  70
          L=2                                                               AJ  80
      109 I=K-L                                                             AJ  90
          IF (I.LE.1) GO TO 139                                             AJ 100
          J=(K+L)/2                                                         AJ 110
          IF (XT(J)-X) 119,129,129                                          AJ 120
      119 L=J                                                               AJ 130
          GO TO 109                                                         AJ 140
      129 K=J                                                               AJ 150
          GO TO 109                                                         AJ 160
      139 CONTINUE                                                          AJ 170
          Y1=YT(K-1)                                                        AJ 180
          Y2=YT(K)                                                          AJ 190
          Y3=YT(K+1)                                                        AJ 200
          X1=XT(K-1)                                                        AJ 210
          X2=XT(K)                                                          AJ 220
          X3=XT(K+1)                                                        AJ 230
          Z1=X-X1                                                           AJ 240
          Z2=X2-X                                                           AJ 250
          Z3=X3-X1                                                          AJ 260
          SINTRP=Y1+(1.+Z2/Z3)*Z1*(Y2-Y1)/(X2-X1)-(Y3-Y2)/(X3-X2)*Z2*Z1/Z3  AJ 270
          RETURN                                                            AJ 280
C                                                                           AJ 290
          END                                                               AJ 300
          FUNCTION AFFFC(A,FANANG,RPM,BARPSI,T,W,SSP,QTRY)                  AK  10
C                                                                           AK  20
C         AFFFEC = FAN FLOW RATE (CFM)                                      AK  30
C         A(1) = DIFFUSER INCLUDED ANGLE (DEG)                              AK  40
```

(Continued)

Table C-4 (cont'd)

```
C     A(2) = DIFFUSER INLET-TO-OUTLET AREA RATIO
C     A(3) = DIFFUSER EXIT DIAMETER (FT)
C     A(4) = FAN DIAMETER (FT)
C     A(5) = HUB-TO-TIP RATIO
C     FANANG = FAN BLADE PITCH (DEG)
C     RPM = FAN RPM
C     BARPSI = BAROMETRIC PRESSURE (PSI)
C     T = DIFFUSER AIR TEMPERATURE (DEG.F)
C     W = DIFFUSER AIR SPECIFIC HUMIDITY (LBM/H2O/LBM DRY AIR)
C     SSP = FAN INLET STATIC GAUGE PRESSURE (IN H2O)
C     QTRY = ESTIMATE OF FAN FLOW RATE (CFM)
C     ANY DESIRED OUTPUT FROM FUNCTION FFR CAN BE TRANSMITTED VIA
C     ARRAY AUXOUT
      EXTERNAL FFR
      DIMENSION TOL(2), A(1), AUXOUT(1), B(11)
      TOL(1)=5.0E3
      TOL(2)=.005
      DO 109 I=1,5
  109 B(I)=A(I)
      B(6)=FANANG
      B(7)=RPM
      B(8)=BARPSI
      B(9)=T
      B(10)=W
      B(11)=SSP
      CALL ROOT (FFR,B,QTRY,TOL,AFFFC,AUXOUT,ICHECK)
      IF (ICHECK.EQ.0) GO TO 119
      RETURN
  119 WRITE (6,129) (A(I),I=1,5),FANANG,RPM,BARPSI,T,W,SSP,TOL,QTRY
      CALL EXIT
C
  129 FORMAT (//1X,30(1H-),37HEXIT FROM AFFFC DUE TO NO CONVERGENCE,1X,7
     1HIN ROOT,30(1H-),/1X,8HARRAY A ,/1X,5E10.3/1X,7HFANANG=,E10.3,2X,4
     2HRPM=,E10.3,2X,7HBARPSI=,E10.3,2X,2HT=,E10.3,2X,2HW=,E10.3,2X,4HSS
     3P=,E10.3/1X,11HTOL(1)/TOL2,2X,E10.3,1H/,E10.3/1X,6H QTRY=,E10.3)
```

(Continued)

Table C-4 (cont'd)

```
C
      END                                                              AK 410
      FUNCTION FFR(A,Q,AUXOUT)                                         AK 420
C                                                                      AL  10
C     FUNCTION FFR CALCULATES THE STACK AIR FLOW RATE                  AL  20
C     (CFM) GIVEN THE PARAMETER ARRAY A AND Q.  ANY DESIRED OUTPUT     AL  30
C     MAY BE TRANSMITTED VIA AUXOUT                                    AL  40
C     A(1) - DIFFUSER INCLUDED ANGLE (DEG)                             AL  50
C     A(2) - DIFFUSER INLET TO OUTLET AREA RATIO                       AL  60
C     A(3) - DIFFUSER EXIT DIAMETER (FT)                               AL  70
C     A(4) - FAN DIAMETER (FT)                                         AL  80
C     A(5) - HUB-TO-TIP RATIO                                          AL  90
C     A(6) - FAN ABSOLUTE PITCH (DEG)                                  AL 100
C     A(7) - FAN RPM                                                   AL 110
C     A(8) - BAROMETRIC PRESSURE (PSIA)                                AL 120
C     A(9) - DIFFUSER TEMPERATURE (DEG.F)                              AL 130
C     A(10) - DIFFUSER SPECIFIC HUMIDITY (LBM H2O/LBM DRY AIR)         AL 140
C     A(11) - STATIC GAUGE PRESSURE AT FAN INLET (IN H2O)              AL 150
C                                                                      AL 160
      DIMENSION A(11), B(2)                                            AL 170
      PI=3.141593                                                      AL 180
      DIAEX=A(3)                                                       AL 190
      RPM=A(7)                                                         AL 200
      HUBTIP=A(5)                                                      AL 210
      DIA=A(4)                                                         AL 220
      DIFANG=A(1)                                                      AL 230
      ARATIO=A(2)                                                      AL 240
      PITCH=A(6)                                                       AL 250
      BARO=A(8)                                                        AL 260
      W=A(10)                                                          AL 270
      T=A(9)                                                           AL 280
      B(1)=PITCH                                                       AL 290
      B(2)=A(7)                                                        AL 300
      RHO=RHOAIR(W,T,BARO)                                             AL 310
      CALL AIRPRO (T,XMU,GARB,GARB,GARB)                               AL 320
                                                                       AL 330
```

(Continued)

Table C-4 (cont'd)

```
      RE=4.0*RHO*Q*60.0/(PI*DIA*XMU)                                     AL 340
C                                                                        AL 350
C     CALCULATE STATIC PRESSURE RISE (IN H2O) BASED ON INPUT Q (CFM)     AL 360
C                                                                        AL 370
      SPR=A(11)                                                          AL 380
C                                                                        AL 390
C     CALCULATE SWIRL VELOCITY (FT/SEC)                                  AL 400
C                                                                        AL 410
      VTHETA=VSWIRL(SPR,RPM,HUBTIP,RHO,DIA)                              AL 420
C                                                                        AL 430
C     CALCULATE STACK LOSS COEFFICIENT                                   AL 440
C                                                                        AL 450
      XK=DIFCOF(DIFANG,ARATIO,RE)                                        AL 460
C                                                                        AL 470
C     CALCULATE FAN RADIUS FOR SINGLE STATION CALCULATIONS               AL 480
C                                                                        AL 490
      R=SQRT((1.0+HUBTIP**2)/2.0)*DIA/2.0                                AL 500
C                                                                        AL 510
C     CALCULATE THROAT AXIAL VELOCITY (FT/SEC)                           AL 520
C                                                                        AL 530
      ATHRT=PI*DIA**2/4.0                                                AL 540
      AEXIT=ATHRT/ARATIO                                                 AL 550
      VAXIAL=Q/(60.0*ATHRT)                                              AL 560
      DEN=RHO/32.17                                                      AL 570
      PFANO=.5*XK*DEN*VAXIAL**2-.5*DEN*VTHETA**2*(1.0-(DIA/DIAEX)**2)-.5 AL 580
     1*DEN*VAXIAL**2*(1.0-ARATIO**2)                                     AL 590
      PFANI=PFANO/5.204-A(11)                                            AL 600
      PRISE=PFANO/5.204-PFANI                                            AL 610
      FFR=ABS(PFANI)+.5*(RHO/32.17)*(Q/60.0)**2/((PI*DIA**2/4.0)**2)*(DI AL 620
     1A**4/(DIA+3.0)**4-1.0)/5.204                                       AL 630
      PLOSS=.5*DEN*VAXIAL**2                                             AL 640
      ALOSS=XK*PLOSS                                                     AL 650
      PSR=.5*DEN*VTHETA**2                                               AL 660
      ASR=PSR*(1.0-(DIA/DIAEX)**2)                                       AL 670
```

(Continued)

Table C-4 (cont'd)

```
      PAR=.5*DEN*VAXIAL**2
      AAR=PAR*(1.0-ARATIO**2)
      PCOR=.5*(RHO/32.17)*(Q/60.0)**2/((PI*DIA**2/4.0)**2)*(DIA**4/(DIA+
     13.0)**4-1.0)/5.204
      RETURN
C
C
      END
      FUNCTION DIFCOF(DIFANG,ARATIO,RE)
C
C     FUNCTION DICOF CALCULATES THE LOSS COEFFICIENT FOR A CONICAL
C     DIFFUSER WITH A DIFANG (DEG) INCLUDED ANGLE; ARATIO, THE
C     INLET TO OUTLET AREA; RE, THE REYNOLDS NUMBER BASED ON INLET
C     DIAMETER AND MASS AVERAGE VELOCITY.  DIFFUSER IS ASSUMED
C     SMOOTH WALLS.
C
      ALPHA=3.14159*DIFANG/180.0
      IF (RE.GE.1.0E5) GO TO 109
      IF (RE.GT.2.0E3) GO TO 119
C
C     FLOW IS LAMINAR
C
      F=RE/64.0
      GO TO 129
  109 CONTINUE
      F=.0032+.221*RE**(-.237)
      GO TO 129
  119 F=.3164*RE**(-.25)
  129 FRICT=F*(1.0-ARATIO**2)/(8.0*SIN(ALPHA))
      PHI=3.2*TAN(ALPHA/2.0)*(TAN(ALPHA/2.0))**.25
      DIF=PHI*(1.0-ARATIO)**2
      DIFCOF=DIF+FRICT
      RETURN
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      FUNCTION VSWIRL(SPR,RPM,HUBTIP,RHO,DIA)                           AN  10
C                                                                       AN  20
C     FUNCTION VSWIRL CALCULATES THE SWIRL VELOCITY (FPS) EXITING THE   AN  30
C     FAN GIVEN:                                                        AN  40
C     SPR - STATIC PRESSURE RISE (IN H2O)                               AN  50
C     RPM - FAN REVOLUTIONS PER MINUTE (RPM)                            AN  60
C     HUBTIP - FAN HUB-TIP RATIO                                        AN  70
C     RHO - MOIST AIR DENSITY (LBM/FT**3)                               AN  80
C     DIA - FAN DIAMETER (FT)                                           AN  90
C                                                                       AN 100
      P=SPR*5.204                                                       AN 110
      DENSIT=RHO/32.17                                                  AN 120
      W=2.0*3.14159*RPM/60.0                                            AN 130
      R=SQRT((1.0+HUBTIP**2)/2.0)*DIA/2.0                               AN 140
      VSWIRL=P/(DENSIT*W*R)                                             AN 150
      RETURN                                                            AN 160
C                                                                       AN 170
      END                                                               AN 180
      FUNCTION FANFLO(A,SPR)                                            AO  10
C                                                                       AO  20
C     FANFLO CALCULATES AIR FLOW RATE (CFM) GIVEN THE STATIC PRESSURE   AO  30
C     RISE                                                              AO  40
C     ACROSS THE FAN (IN. H2O).  REFER TO HUDSON PRODUCTS CORPORATION   AO  50
C     FAN PERFORMANCE CURVES, DATA SHEET T-323-14                       AO  60
C     A(1)=FAN ABSOLUTE PITCH (DEG).                                    AO  70
C     A(2)=FAN RPM                                                      AO  80
C     PRISE - FAN STATIC PRESSURE RISE (IN. H2O)                        AO  90
C                                                                       AO 100
      DIMENSION Q2(5), Q6(13), QTEN(15), Q14(12), Q18(14), Q22(7), P2(5) AO 110
     1, P6(13), PTEN(15), P14(12), P18(14), P22(7), VPTAB(14), QVP(14), AO 120
     2A(1)                                                              AO 130
C                                                                       AO 140
C     FILL FAN CURVE ARRAYS                                             AO 150
C                                                                       AO 160
```

(Continued)

Table C-4 (cont'd)

```
      DATA P2/.16,.20,.24,.28,.889/
      DATA Q2/1.105E6,1.075E6,1.04E6,1.0E6,0.0/
      DATA P6/.24,.28,.32,.36,.4,.44,.48,.52,.56,.60,.64,.68,1.063/
      DATA Q6/1.43E6,1.39E6,1.36E6,1.33E6,1.29E6,1.26E6,1.22E6,1.18E6,1.
     115E6,1.1E6,1.06E6,1.01E6,0.0/
      DATA PTEN/.36,.4,.48,.6,.64,.72,.8,.88,.96,1.06,1.11,1.15,1.19,1.2
     105,1.214/
      DATA QTEN/1.74E6,1.7E6,1.63E6,1.5E6,1.47E6,1.39E6,1.3E6,1.22E6,1.1
     13E6,1.0E6,.9E+6,.8E+6,.6E+6,.4E6,0.0/
      DATA P14/.52,.6,.68,.76,.84,.92,1.0,1.08,1.16,1.24,1.28,1.388/
      DATA Q14/2.12E6,2.03E6,1.93E6,1.83E6,1.72E6,1.62E6,1.52E6,1.41E6,1
     1.29E6,1.14E6,1.0E6,0.0/
      DATA P18/.8,.88,.96,1.04,1.12,1.2,1.28,1.36,1.38,1.38,1.37,1.36,1.
     135,1.32/
      DATA Q18/2.22E6,2.13E6,2.04E6,1.94E6,1.84E6,1.71E6,1.57E6,1.36E6,1
     1.20E6,1.0E6,.8E6,.6E6,.4E6,0.0/
      DATA P22/1.12,1.2,1.28,1.36,1.40,1.42,1.37/
      DATA Q22/2.27E6,2.17E6,2.07E6,1.93E6,1.8E6,1.67E6,0.0/
      DATA VPTAB/0.,.1,.16,.2,.24,.28,.32,.36,.4,.44,.48,.52,.56,.6/
      DATA QVP/0.,1.0E6,1.06E6,1.19E6,1.33E6,1.45E6,1.56E6,1.67E6,1.76E6
     1,1.86E6,1.95E6,2.05E6,2.12E6,2.19E6,2.27E6/
      DATA IFIRST/0/
      ANGLE=A(1)
      RPM=A(2)
      PRISE=SPR*(119.0/RPM)**2
      N2=5
      N6=13
      NTEN=15
      N14=12
      N18=14
      N22=7
      IF (IFIRST.NE.0) GO TO 169
      DO 109 I=1,N2
         Q=SINTRP(P2,Q2,P2(I),N2)
         PV=SINTRP(QVP,VPTAB,Q,14)
```

(Continued)

Table C-4 (cont'd)

```
  109 P2(I)=P2(I)-PV                                                    AO  520
      DO 119 I=1,N6                                                     AO  530
         Q=SINTRP(P6,Q6,P6(I),N6)                                       AO  540
         PV=SINTRP(QVP,VPTAB,Q,14)                                      AO  550
  119 P6(I)=P6(I)-PV                                                    AO  560
      DO 129 I=1,NTEN                                                   AO  570
         Q=SINTRP(PTEN,QTEN,PTEN(I),NTEN)                               AO  580
         PV=SINTRP(QVP,VPTAB,Q,14)                                      AO  590
  129 PTEN(I)=PTEN(I)-PV                                                AO  600
      DO 139 I=1,N14                                                    AO  610
         Q=SINTRP(P14,Q14,P14(I),N14)                                   AO  620
         PV=SINTRP(QVP,VPTAB,Q,14)                                      AO  630
  139 P14(I)=P14(I)-PV                                                  AO  640
      DO 149 I=1,N18                                                    AO  650
         Q=SINTRP(P18,Q18,P18(I),N18)                                   AO  660
         PV=SINTRP(QVP,VPTAB,Q,14)                                      AO  670
  149 P18(I)=P18(I)-PV                                                  AO  680
      DO 159 I=1,N22                                                    AO  690
         Q=SINTRP(P22,Q22,P22(I),N22)                                   AO  700
         PV=SINTRP(QVP,VPTAB,Q,14)                                      AO  710
  159 P22(I)=P22(I)-PV                                                  AO  720
      IFIRST=1                                                          AO  730
  169 CONTINUE                                                          AO  740
      IF (ANGLE.GT.22.0) GO TO 179                                      AO  750
      IF (ANGLE.LT.2.0) GO TO 179                                       AO  760
      IF (ANGLE.LT.6.0) GO TO 189                                       AO  770
      IF (ANGLE.LT.10.0) GO TO 199                                      AO  780
      IF (ANGLE.LT.14.0) GO TO 209                                      AO  790
      IF (ANGLE.LT.18.0) GO TO 219                                      AO  800
C                                                                       AO  810
C     ANGLE IS GE 18.0 DEGREES                                          AO  820
C                                                                       AO  830
      FL01=SINTRP(P14,Q14,PRISE,N14)                                    AO  840
      FL02=SINTRP(P18,Q18,PRISE,N18)                                    AO  850
      FL03=SINTRP(P22,Q22,PRISE,N22)                                    AO  860
```

(Continued)

Table C-4 (cont'd)

```
      ANG1=14.0                                                         AO  870
      ANG2=18.0                                                         AO  880
      ANG3=22.0                                                         AO  890
      GO TO 229                                                         AO  900
  179 WRITE (6,239) ANGLE                                               AO  910
      CALL EXIT                                                         AO  920
  189 CONTINUE                                                          AO  930
C                                                                       AO  940
C     ANGLE GE 2.0 BUT LT 6.0                                           AO  950
C                                                                       AO  960
      FL01=SINTRP(P2,Q2,PRISE,N2)                                       AO  970
      FL02=SINTRP(P6,Q6,PRISE,N6)                                       AO  980
      FL03=SINTRP(PTEN,QTEN,PRISE,NTEN)                                 AO  990
      ANG1=2.0                                                          AO 1000
      ANG2=6.0                                                          AO 1010
      ANG3=10.0                                                         AO 1020
      GO TO 229                                                         AO 1030
  199 CONTINUE                                                          AO 1040
C                                                                       AO 1050
C     ANGLE IS GE 6.0 BUT LT 10.0                                       AO 1060
C                                                                       AO 1070
      FL01=SINTRP(P2,Q2,PRISE,N2)                                       AO 1080
      FL02=SINTRP(P6,Q6,PRISE,N6)                                       AO 1090
      FL03=SINTRP(PTEN,QTEN,PRISE,NTEN)                                 AO 1100
      ANG1=2.0                                                          AO 1110
      ANG2=6.0                                                          AO 1120
      ANG3=10.0                                                         AO 1130
      GO TO 229                                                         AO 1140
  209 CONTINUE                                                          AO 1150
C                                                                       AO 1160
C     ANGLE IS GE 10.0 BUT LT 14.0                                      AO 1170
C                                                                       AO 1180
      FL01=SINTRP(P6,Q6,PRISE,N6)                                       AO 1190
      FL02=SINTRP(PTEN,QTEN,PRISE,NTEN)                                 AO 1200
      FL03=SINTRP(P14,Q14,PRISE,N14)                                    AO 1210
```

(Continued)

Table C-4 (cont'd)

```
      ANG1=6.0                                                           AO 1220
      ANG2=10.0                                                          AO 1230
      ANG3=14.0                                                          AO 1240
      GO TO 229                                                          AO 1250
  219 CONTINUE                                                           AO 1260
C                                                                        AO 1270
C     ANGLE IS GE 14.0 BUT LT 18.0                                       AO 1280
C                                                                        AO 1290
      FL01=SINTRP(PTEN,QTEN,PRISE,NTEN)                                  AO 1300
      FL02=SINTRP(P14,Q14,PRISE,N14)                                     AO 1310
      FL03=SINTRP(P18,Q18,PRISE,N18)                                     AO 1320
      ANG1=10.0                                                          AO 1330
      ANG2=14.0                                                          AO 1340
      ANG3=18.0                                                          AO 1350
  229 CONTINUE                                                           AO 1360
C                                                                        AO 1370
C     DETERMINE COEFFICIENTS FOR SECOND ORDER CURVE FIT OF TYPE          AO 1380
C     Y=A+BX+C*X**2                                                      AO 1390
C                                                                        AO 1400
      Y1=FL01                                                            AO 1410
      Y2=FL02                                                            AO 1420
      Y3=FL03                                                            AO 1430
      X1=ANG1                                                            AO 1440
      X2=ANG2                                                            AO 1450
      X3=ANG3                                                            AO 1460
      C=((X1-X2)*(Y2-Y3)-(Y1-Y2)*(X2-X3))/((X1-X2)*(X2**2-X3**2)-(X2-X3) AO 1470
     1*(X1**2-X2**2))                                                    AO 1480
      B=(Y1-Y2-C*(X1**2-X2**2))/(X1-X2)                                  AO 1490
      AA=Y1-B*X1-C*X1**2                                                 AO 1500
      FANFLO=(AA+B*ANGLE+C*ANGLE**2)*RPM/119.0                           AO 1510
      RETURN                                                             AO 1520
C                                                                        AO 1530
  239 FORMAT (//1X,40(1H-),26H EXIT FROM FUNCTION FANFLO,40(1H-),/1X37(1 AO 1540
```

(Continued)

Table C-4 (cont'd)

```
     1H-),32HFAN ANGLE TOO LARGE OR TOO SMALL,37(1H-),/54X,6H ANGE=,E10.
     23)
C
      END
      FUNCTION FANP(PITCH,Q,FISP,RPM)
C
C     FANP CALCULATES THE FAN STATIC PRESSURE RISE (IN.H20)
C     PITCH - FAN BLADE ABSOLUTE PITCH (DEG)
C     Q - FAN FLOW RATE (CFM)
C     FISP - FAN INLET STATIC PRESSURE
C
      DIMENSION A(2), TOL(2)
      EXTERNAL FANFLO
      SP=ABS(FISP)
      TOL(1)=1.0E3
      TOL(2)=.001
      A(1)=PITCH
      A(2)=RPM
      CALL SECANN (FANFLO,A,SP,.95*SP,Q,FANP,TOL,ICHECK,15)
      IF (ICHECK.EQ.0) GO TO 109
      RETURN
  109 WRITE (6,119) PITCH,Q,FISP
      CALL EXIT
C
  119 FORMAT (//1X,40(1H-),22HNO CONVERGENCE IN FANP,40(1H-),/,1X,10X,7H
     1 PITCH=,E10.3,2HQ=,E10.3,26HFAN INLET STATIC PRESSURE=,E10.3)
C
      END
```

(Continued)

Table C-4 (cont'd)

```
      FUNCTION PFORQ(ANGLE,RPM,Q)                                       AQ  10
      DIMENSION Q2(5), Q6(13), QTEN(15), Q14(12), Q18(14), Q22(7), P2(5) AQ  20
     1, P6(13), PTEN(15), P14(12), P18(14), P22(7), VPTAB(14), QVP(14)   AQ  30
      DATA Q2/0.0,1.0E6,1.04E6,1.075E6,1.105E6/                          AQ  40
      DATA P2/.889,.28,.24,.20,.16/                                      AQ  50
      DATA Q6/0.0,1.01E6,1.06E6,1.1E6,1.15E6,1.18E6,1.22E6,1.26E6,1.29E6 AQ  60
     1,1.33E6,1.36E6,1.39E6,1.43E6/                                      AQ  70
      DATA P6/1.063,.68,.64,.60,.56,.52,.48,.44,.4,.36,.32,.28,.24/      AQ  80
      DATA QTEN/0.0,.4E6,.6E6,.8E6,.9E6,1.0E6,1.13E6,1.22E6,1.3E6,1.39E6 AQ  90
     1,1.47E6,1.5E6,1.63E6,1.7E6,1.74E6/                                 AQ 100
      DATA PTEN/1.214,1.205,1.19,1.15,1.11,1.06,.96,.88,.8,.72,.64,.60,. AQ 110
     148,.4,.36/                                                         AQ 120
      DATA Q14/0.0,1.0E6,1.14E6,1.29E6,1.41E6,1.52E6,1.62E6,1.72E6,1.83E AQ 130
     16,1.93E6,2.03E6,2.12E6/                                            AQ 140
      DATA P14/1.338,1.28,1.24,1.16,1.08,1.0,.92,.84,.76,.68,.6,.52/     AQ 150
      DATA Q18/0.0,.4E6,.6E6,.8E6,1.0E6,1.2E6,1.36E6,1.57E6,1.71E6,1.84E AQ 160
     16,1.94E6,2.04E6,2.13E6,2.22E6/                                     AQ 170
      DATA P18/1.32,1.35,1.36,1.37,1.38,1.38,1.36,1.28,1.2,1.12,1.04,.96 AQ 180
     1,.88,.8/                                                           AQ 190
      DATA Q22/0.0,1.67E6,1.8E6,1.93E6,2.07E6,2.17E6,2.27E6/             AQ 200
      DATA P22/1.37,1.42,1.40,1.36,1.28,1.2,1.12/                        AQ 210
      DATA VPTAB/0.0,.1,.16,.2,.24,.28,.32,.36,.4,.44,.48,.52,.56,.6/    AQ 220
      DATA QVP/0.0,1.0E6,1.19E6,1.33E6,1.45E6,1.56E6,1.67E6,1.76E6,1.86E AQ 230
     16,1.95E6,2.05E6,2.12E6,2.19E6,2.27E6/                              AQ 240
      DATA IFIRST/0/                                                     AQ 250
      QA=Q*119.0/RPM                                                     AQ 260
      N2=5                                                               AQ 270
      N6=13                                                              AQ 280
      NTEN=15                                                            AQ 290
      N14=12                                                             AQ 300
      N18=14                                                             AQ 310
      N22=7                                                              AQ 320
      IF (IFIRST.NE.0) GO TO 169                                         AQ 330
      DO 109 I=1,N2                                                      AQ 340
  109 P2(I)=P2(I)-SINTRP(QVP,VPTAB,Q2(I),14)                             AQ 350
```

(Continued)

Table C-4 (cont'd)

```
      DO 119 I=1,N6                                              AQ  360
  119 P6(I)=P6(I)-SINTRP(QVP,VPTAB,Q6(I),14)                     AQ  370
      DO 129 I=1,NTEN                                            AQ  380
  129 PTEN(I)=PTEN(I)-SINTRP(QVP,VPTAB,QTEN(I),14)               AQ  390
      DO 139 I=1,N14                                             AQ  400
  139 P14(I)=P14(I)-SINTRP(QVP,PVTAB,Q14(I),14)                  AQ  410
      DO 149 I=1,N18                                             AQ  420
  149 P18(I)=P18(I)-SINTRP(QVP,PVTAB,Q18(I),14)                  AQ  430
      DO 159 I=1,N22                                             AQ  440
  159 P22(I)=P22(I)-SINTRP(QVP,PVTAB,Q22(I),14)                  AQ  450
      IFIRST=1                                                   AQ  460
  169 PA2=SINTRP(Q2,P2,QA,N2)                                    AQ  470
      PA6=SINTRP(Q6,P6,QA,N6)                                    AQ  480
      PATEN=SINTRP(QTEN,PTEN,QA,NTEN)                            AQ  490
      PA14=SINTRP(Q14,P14,QA,N14)                                AQ  500
      PA18=SINTRP(Q18,P18,QA,N18)                                AQ  510
      PA22=SINTRP(Q22,P22,QA,N22)                                AQ  520
      IF (ANGLE.GT.22.0) GO TO 179                               AQ  530
      IF (ANGLE.LT.2.0) GO TO 179                                AQ  540
      IF (ANGLE.LT.6.0) GO TO 189                                AQ  550
      IF (ANGLE.LT.10.0) GO TO 199                               AQ  560
      IF (ANGLE.LT.14.0) GO TO 209                               AQ  570
      IF (ANGLE.LT.18.0) GO TO 219                               AQ  580
      PA1=PA14                                                   AQ  590
      PA2=PA18                                                   AQ  600
      PA3=PA22                                                   AQ  610
      ANG1=14.0                                                  AQ  620
      ANG2=18.0                                                  AQ  630
      ANG3=22.0                                                  AQ  640
      GO TO 229                                                  AQ  650
  179 WRITE (6,239) ANGLE                                        AQ  660
      CALL EXIT                                                  AQ  670
  189 PA1=PA2                                                    AQ  680
      PA2=PA6                                                    AQ  690
```

(Continued)

Table C-4 (cont'd)

```
      PA3=PATEN
      ANG1=2.0                                                          AQ  700
      ANG2=6.0                                                          AQ  710
      ANG3=10.0                                                         AQ  720
      GO TO 229                                                         AQ  730
  199 PA1=PA2                                                           AQ  740
      PA2=PA6                                                           AQ  750
      PA3=PATEN                                                         AQ  760
      ANG1=2.0                                                          AQ  770
      ANG2=6.0                                                          AQ  780
      ANG3=10.0                                                         AQ  790
      GO TO 229                                                         AQ  800
  209 PA1=PA6                                                           AQ  810
      PA2=PATEN                                                         AQ  820
      PA3=PA14                                                          AQ  830
      ANG1=6.0                                                          AQ  840
      ANG2=10.0                                                         AQ  850
      ANG3=14.0                                                         AQ  860
      GO TO 229                                                         AQ  870
  219 PA1=PATEN                                                         AQ  880
      PA2=PA14                                                          AQ  890
      PA3=PA18                                                          AQ  900
      ANG1=10.0                                                         AQ  910
      ANG2=14.0                                                         AQ  920
      ANG3=18.0                                                         AQ  930
  229 Y1=PA1                                                            AQ  940
      Y2=PA2                                                            AQ  950
      Y3=PA3                                                            AQ  960
      X1=ANG1                                                           AQ  970
      X2=ANG2                                                           AQ  980
      X3=ANG3                                                           AQ  990
      C=((X1-X2)*(Y2-Y3)-(Y1-Y2)*(X2-X3))/((X1-X2)*(X2**2-X3**2)-(X2-X3) AQ 1000
     1*(X1**2-X2**2))                                                   AQ 1010
      B=(Y1-Y2-C*(X1**2-X2**2))/(X1-X2)                                 AQ 1020
      AA=Y1-B*X1-C*X1**2                                                AQ 1030
                                                                        AQ 1040
```

(Continued)

Table C-4 (cont'd)

```
      PFORQ=(AA+B*ANGLE+C*ANGLE**2)*(RPM/119.0)**2                      AQ 1050
      RETURN                                                            AQ 1060
C                                                                       AQ 1070
  239 FORMAT (1X, 51H---FAN PITCH LESS THAN OR GREATER THAN FAN CURVE---  AQ 1080
     1)                                                                 AQ 1090
C                                                                       AQ 1100
      END                                                               AQ 1110
```

TABLE C-5

SAMPLE OUTPUT LISTING

```
--------------------------------------------------------------------------------------------------
---------------------------------TVA COOLING TOWER TEST RESULTS------------------------------------
--------------------------------------------------------------------------------------------------

                                   DATE  17
                                   WET/DRY FILL TEST
                                   WINTER
                                   TEST BLOCK NUMBER  2
                                   TEST NUMBER 12
                                   NUMBER  1 REPEAT


                                        AMBIENT AIR STATES
                                TEMPERATURE(DEG. F)/DEW POINT(DEG. F)

                                  36.6/ 31.8              37.1/ 32.0

                                     BAROMETRIC PRESSURE(IN HG)
                                               25.92


                                       TOWER INLET AIR STATES
                                TEMPERATURE(DEG. F)/DEWPOINT(DDEG. F)

                                            37.7/ 34.7
                       36.6/ 33.7           37.5/ 35.4              36.3/ 35.1
                       37.5/ 35.2           36.7/ 35.7              37.1/ 33.5
                       36.3/ 33.4           36.8/ 37.4              37.7/ 34.4
```

(Continued)

Table C-5 (cont'd)

		WET FILL INLET AIR TEMPERATURE(DEG. F)		
		67.2		
	67.2	67.2	67.2	
	67.2	67.2	67.2	
		WET FILL OUTLET AIR STATES TEMPERATURE(DEG. F)/DEW POINT(DEG. F)		
		81.7/ 77.6		
	70.1/ 66.3	79.5/ 76.3	71.5/ 76.7	
	65.9/ 62.4	73.6/ 74.8	66.2/ 66.3	
	62.2/ 59.5	67.5/ 69.9	61.8/ 61.1	
		STACK AIR STATES TEMPERATURE(DEG. F)/DEWPINT(DEG. F)		
64.0/ 64.3	63.9/ 61.7	62.5/ 58.5	72.3/999.0	78.8/ 81.2

(Continued)

Table C-5 (cont'd)

```
          -------------------------FAN-STACK RESULTS-------------------------
                  FAN VOLTAGE(V)                   CURRENT(A)                     POWER(KW)
                  4.140E+03              3.600E+01 3.550E+01 3.500E+01            1.878E+02
RPM      BLADE ANGLE     PRESSURE RISE(IN WG)     FLOWRATE(CFM)     COMBINED STATIC EFFICIENCY
150.0       12.0                       .605         2.1E+06                  1.054
            HEAD COEFFICIENT(IN WG/RPM-2-FT-2)        FLOW COEFFICIENT(CFM/RPM-FT-3)
                        2.628E-08                                  4.275E-01
             HEAD COEFFICIENT(DIMENSIONLESS)          FLOW COEFFICIENT(DIMENSIONLESS)
                        6.426E-06                                  6.804E-02
                                  AIR FLOW FROM FAN CURVE(CFM)
                                          2.082E+06
```

(Continued)

Table C-5 (cont'd)

```
                  -------------------DRY TOWER HEAT TRANSFER RESULTS-------------------
AVERAGE AIR INLET TEMPERATURE(DEG.F)/WET BULB(DEG.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY(BTU/LBM)
               37.0           36.1           34.8            .00423            13.5

AVERAGE AIR OUTLET TEMPERATURE(DEG.F)/WET BULB(DEG. F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY(BTU/LBM)
               67.9           51.3           34.8            .00423            20.9

          WATER INLET TEMPERATURE(DEG.F)        WATER OUTLET TEMPERATURE(DEG.F)
                  88.4                                   73.8

         WATER FLOWRATE(LBM/HR)/(GPM)          PERCENT DIFFERENCE IN FLOWRATE
                                                     AS PERCEIVED BY
                                                THE MANOMETER AND TRANSDUCER
         2.234E+06/ 4.482E+03                          206.5

          AIR FLOWRATE(LBM/HR)              PERCENT DIFFERENCE BETWEEN STACK
                                                AND TOWER FACE FLOWRATE
               4.723E+06                               -100.0

AIR-SIDE REYNOLDS NUMBER       FILM COEFFICIENT       NUSSELT NUMBER       STANTON NUMBER       J FACTOR
      1.845E+03                      19.5                  16.1                 .012              .010

      ENERGY EXCHANGE BASED         ENERGY EXCHANGE BASED        ENERGY CONSERVATION ERROR
         ON AIR STATES                  ON WATER STATES
         3.514E+07                      3.261E+07                      7.8

   ENERGY EXCHANGE BASED     PERCENT ERROR IN CALCULATED     ENERGY EXCHANGE BASED     ENERGY CONSERVATION
      ON AIR STATES              AIR ENERGY EXCHANGE            ON WATER STATES        ERROR(PERCENT)
    5.946E+07                        14.5                          5.095E+07                 16-7
```

(Continued)

Table C-5 (cont'd)

```
                    --------------------WET TOWER HEAT AND MASS TRANSFER RESULTS--------------------
AVERAGE AIR INLET TEMPERATURE(DEG.F)/WET BULB(DEG.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY(BTU/LBM)
                    67.9              51.3          34.8            .00423             20.9

AVERAGE AIR OUTLFT TEMPERATURE(DEG.F)/WET BULH(CEG. F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY(BTU/LBM)
                    70.0              69.4          69.1            .01527             33.5

            WATER INLET TEMPERATURE(DEG.F)         WATER OUTLET TEMPERATURE(DEG.F)
                    87.7                                    65.6

   WATER FLOWRATE(LBM/HR)/(GPM)       PERCENT DIFFERENCE IN FLOWRATE        WATER LOADING(LBM/HR-FT-FT)
                                            AS PERCEIVED BY
                                      THE MANCMETER AND TRANSDUCER
   2.316E+06/ 4.646E+03                       100.0                             3.126E+03

DRY AIR FLCWRATE(LBM/HR)        AIR LOADING(LBM/HR-FT-FT)        PERCENT DIFFERENCE BETWEEN STACK
                                                                   AND TOWER FACE FLOWRATE
      4.723E+06                      2.904E+03                             -100.0

NUMBER CF VERTICAL TOWER DIVISIONS   NUMBER OF HORIZONTAL TOWER DIVISIONS   HEIGHT(FT)   WIDTH(FT)   DEPTH(FT)
              5                                     7                          39.5         41.2        18.0

CALCULATED AIR OUTLET TEMPERATURE(DEG.F)/WET BULB(DEE.F)/DEWPOINT(DEG.F)/SPECIFIC HUMIDITY(LBM/LBM)/ENTHALPY(BTU/LBM)
              72.2                          67.2          64.8           .01313                  31.7

MASS TRANSFER COFFFICIENT(LBM/HR-FT-3)    NUMBER OF TRANSFER UNITS    WATER LOSS BY EVAPORATION(LBM/HR) IN FILL
              143.9                                1.826                        52130.3
```

(Continued)

Table C-5 (cont'd)

WATER LOSS(LBM/HR) IN TOWER	FILL WATER LOSS AS A PERCENT OF AIR FLOWRATE	FILL WATER LOSS AS A PERCENT OF WATER FLOWRATE
45666.5	1.1	2.3

WATER TEMPERATURES(DEG. F)

HOT WATER INLET	DISTRIBUTION BASIN	HEAT EXCHANGER OUTLET	HEAT EXCHANGER OUTLET	COLD WATER RETURN
88.4	87.7	73.8	73.8	70.7

FILL WATER TEMPERATURE DISTRIBUTION(DEG.F)
(LEFT-TO-RIGHT IS EQUIVALENT TO FRONT-TO-REAR IN FILL)

LEVEL I

			70.0			
	77.8		71.3		74.2	
79.1		75.3		79.5		80.5
	79.8		83.4		83.0	
			82.7			

LEVEL II

66.0	74.8	78.2	78.3

LEVEL III

			58.3			
	57.8		69.5		70.7	
61.9		68.9		73.1		73.2
	62.8		64.7		66.1	
			61.2			

LEVEL IV

59.1	64.5	69.0	70.0

(Continued)

Table C-5 (cont'd)

```
                         TOWER INLET VELOCITIES(FT/SEC)

                            0            0            0
                            0            0            0
                            0            0            0


                         STACK AIR VELOCITIES(FT/SEC)

                            0          46.4         13.1
                         29.1          21.3         36.3
                         38.3          56.4         27.3


                 STACK STATIC PRESSURE BELOW ATMOSPHERIC PRESSURE WAS  6.054E-01 IN WG
```

APPENDIX D

DATA CORRELATION COMPUTER CODES

In Appendix C the computer code that was used to reduce raw tower thermal and flow test data (program ADVTOW) was described. The output data produced by ADVTOW were then subjected to analysis (correlation) as described in Sections 4.4 and 4.5. This appendix is an explanation of the correlation computer codes.

D.1 INPUT DATA FILES

In Appendix C the printed output from the data reduction code was shown. Table D-1 shows examples of the punched reduced data output from ADVTOW. When all data reduction was completed, the data from all similar tests (WET, WET/DRY, etc.) were merged to form input files for the correlation programs.

The following is an explanation of the data, line by line, from each example data file:

I. WET tests:
  a. Line 1:
    1. Six-digit run identifier
    2. Day of test run
    3. Water loading L (lbm/hr-ft^2)
    4. Air loading G (lbm/hr-ft^2)
    5. Water flow to fill (lbm/hr)
    6. Airflow through fill (lbm/hr)
    7. Mass transfer coefficient (lbm/hr-ft^3)
    8. Number of transfer units (NTU)
  b. Line 2:
    1. Average fill inlet air dry bulb temperature (°F)
    2. Average fill outlet air dry bulb temperature (°F)
    3. Average fill inlet dewpoint temperature (°F)
    4. Average fill outlet dewpoint temperature (°F)

        5. Inlet water temperature (°F)
        6. Average exit water temperature (°F)
        7. Tower basin return line temperature (°F)
    c. Line 3:
        1. Water loss as a percent of inlet flow rate (%)
        2. Energy balance error (%)
    d. Line 4:
        1. Run identifier (repeated)
        2. Day of run (repeated)
        3. Fan inlet pressure (below atm) (in Wg)
        4. Airflow rate through fan (ft^3/min)
        5. Fan speed (rpm)
        6. Fan angle of attack (degrees)
        7. Fan input power (hp)
        8. Fan flow coefficient ($cfm/rpm\text{-}ft^3$)
    e. Line 5:
        1. Fan head coefficient (inches $H_2O/rpm^2\text{-}ft^2$)
        2. Dimensionless fan flow coefficient
        3. Dimensionless fan head coefficient
        4. Fan-stack-drive overall efficiency (%)

II. WET/DRY tests:
    a. Line 1 same as line 1 above.
    b. Line 2 same as line 2 above.
    c. Line 3 same as line 3 above.
    d. Line 4:
        1. Run identifier (repeated)
        2. Day of run (repeated)
        3. Reynolds number of air in heat exchanger (dimensionless)
        4. Air-side heat transfer coefficient ($Btu/hr\text{-}ft^2\text{-}°F$)
        5. Air-side Nusselt number (dimensionless)
        6. Colburn j factor (dimensionless)
        7. Airflow rate through fill (lbm/hr)
        8. Average tower air inlet dry bulb temperature (°F)
    e. Line 5:
        1. Average tower air inlet dewpoint temperature (°F)
        2. Heat exchanger average outlet dry bulb temperature (°F)
        3. Heat exchanger water inlet temperature (°F)
        4. Average heat exchanger outlet water temperature (°F)
        5. Water flow rate through exchanger (lbm/hr)
        6. Energy balance error between air and water in exchanger (%)
    f. Line 6 same as line 4 in WET tests
    g. Line 7 same as line 5 in WET tests

III. DRY tests:
    a. Line 1 same as line 4 in WET/DRY tests
    b. Line 2 same as line 5 in WET/DRY tests

c. Line 3 same as line 4 in WET tests
d. Line 4 same as line 5 in WET tests

IV. FAN tests:
These data are arranged the same as WET tests. Only the leading digit 4 in the run identifier shows this to be a fan test.

V. SHORT tests:
These data are arranged the same as WET tests. Only the leading digit 7 in the run identifier shows this to be a SHORT fill test.

D.2 Ka CORRELATION CODE

Table D-2 is a listing of the Ka correlation code. Within the code certain statement blocks have been defined. The following are explanations for these blocks.

A. Read Fixed Data. At the start of each run, some fixed data are read. These data are:

NOSE: A variable that indicates the number of blocks of data to be used in the correlation, out of the total data input file. For example, if we wish to correlate only winter WET data and the winter WET data (index 11xxxx) are runs 1 through 125 and runs 227 through 266 out of runs 1 through 539, then NOSE=2. That is, the data to be correlated lie in two blocks in the entire WET data file.

NOT: A parameter that indicates which method of temperature dependency will be used in the Ka correlation. The following values apply:

NOT=1. No temperature effect.
2. Inlet water temperature.
3. Outlet water tempeature.
4. Average water temperature.
5. Inlet air dry bulb temperature.
6. Outlet air dry bulb temperature.
7. Average air dry bulb temperature.
8. Average fluid temperature.

JSINB: After the correlation is obtained, histograms of the parameter $\phi_i = Ka_i^*/Ka_i$ and deviations σ_i are prepared. The variable JSINB is the width of each interval in the histogram.

/

RANGE: This variable is the total span of the histogram. If, for example, RANGE=3 and JSINB=30, there would be 30 intervals of width 0.1 in the histogram.

NERR: A parameter indicating whether any culling of data is to be performed. NERR=0 indicates no culling. NERR≠0 indicates some data are to be culled.

ERRMAX: When data are to be culled, the maximum or minimum value of the culled parameter is ERRMAX. For example, if we wish to consider correlation of all data for L < 10,000, then ERRMAX=10,000. See block G below for details.

NOS(I): The number of the first data set in the I^{th} block to be used in the correlation.

NOE(I): The number of the last data set in the I^{th} block to be used in the correlation.

As an example of the relationship between NOSE, NOS, and NOE, if we wish, as in the example above, to correlate only winter data and these data occur in two blocks of the entire WET data file, runs 1 through 125 and runs 227 through 266, then:

NOSE=2
NOS(1)=1
NOS(2)=227
NOE(1)=125
NOE(2)=266

B. Read Data Sets. Data sets are read one at a time. The first card is read and values of L, G, Ka and NTU and test day are put into matrices. Note that the run identifier is read as six individual digits. This is so the first digit, test type, may be examined to insure that, for example, no DRY data are read when we want to correlate Ka from the WET data file. Block C, where the second card is read, is explained below. The third card is read to obtain energy balance error. Finally, the program skips irrelevant cards so that the first card in the next data set is "up front" when the program returns to read the next data set.

C. This block of statements reads and interprets the second card in a data set. Depending on the value of NOT, the appropriate fluid temperature is put into the matrix TEMP.

D. If we wish to correlate Ka with no temperature dependency, then TEMP(I)=1, which forces exponent c in the Ka correlation to be 0.

E. This block controls the printing of the top of the output listing, which changes depending upon which temperature is used in the Ka correlation.

F. In this block a complete input data file is reduced to the data file to be correlated, depending on NOSE, NOS and NOE (see above). Also, where logarithms of parameters are needed (Ka, L, G and T), they are computed here.

G. This is the culling block. The logic is set up here to examine the value of L against ERRMAX. If XLUSE(I) > ERRMAX, that particular data set is bypassed.

H. Summing variables for the least squares analysis are zeroed.

I. Sums for the least squares analysis are computed.

J. Correlation coefficients are computed.

K. The coefficient of multiple determination is computed.

L. Matrices for least squares are established and the system of equations is solved by the canned routine LINEQ1, which solves NEQ simultaneous equations.

M. The parameters C_o, a, b and c are obtained from the output of LINEQ1.

N. For each data set, the value of Ka_i^*, i.e., the value from the correlation, is obtained. The values of ϕ_i and T are also computed.

O. Standard error of estimate is computed and the deviation of each data set is obtained.

P. The Table D-3 is printed out (see below).

Q. A histogram of ϕ_i is prepared and printed.

R. A histogram of σ_i is prepared and printed.

Table D-3 is an example of output data from the Ka correlation program. The output is self-explanatory except for the following column headings:

I = Number of data set in entire file.
NO = Number of data set in used data file.
DAY = Day test was run.

L = Water loading.
G = Air loading.
T = Temperature in correlation.
KAD = Ka from tower test.
KAC = Ka from correlation.
NTUD = NTU from tower test.
NTUC = NTU from correlation.
ERR = Error of energy balance.
SIGMA = Number of standard deivations.
DEV = $|\phi_i - \phi|$.

Below the comparison table are the standard estimate of error, the ϕ_i and σ_i histograms and finally the correlation coefficients C_o, a, b, and c.

D.3 WATER LOSS CORRELATION CODE

Table D-4 is a listing of the water loss ($\Delta L/L$) correlation code. This code is quite similar to the Ka correlation code explained above. As in that code, statements are blocked in the listing and perform the following functions:

A. See block A in Section D.2.

B. The same as block B in Section D.2, except that $\Delta L/L$ is read from the third data card as the dependent parameter XMATAB(I), rather than Ka from the first card.

C. Similar to block C in Section D.2 except that humidity differences are computed and put in TEMP(I) rather than temperatures, as was the case in Section D.2.

D. Same as block E in Section D.2.

E. Same as block F in Section D.2.

F. Same as block G in Section D.2.

G. Same as block H in Section D.2.

H. Same as block I in Section D.2.

I. Same as block J in Section D.2.

J. Same as block K in Section D.2.

K. Same as block L in Section D.2.

L. Same as block M in Section D.2.

M. Same as block N in Section D.2.

N. Same as block O in Section D.2.

O. Same as block P in Section D.2.

P. Same as block Q in Section D.2.

Q. Same as block R in Section D.2.

At the end of the code are two functions. The first one, WATSAP, computes saturation pressure of water as a function of temperature. This function is called in the second function, SATHUM, which computes absolute air humidity ω as a function of air saturation temperature and air pressure.

An example of the output from the water loss correlation code is presented in Table D-5. Here again, the format is about the same as for the Ka correlation code. The only changes are three column headings. Here MAD is the percent water loss as determined from tower test data and MAC is the same parameter from the water loss correlation. In Table D-5, T is the humidity difference indicated in the table title block.

D.4. HEAT EXCHANGER AIR-SIDE HEAT TRANSFER COEFFICIENT CORRELATION CODE

Table D-6 is the code written to correlate Colburn j factor with air Reynolds number, as discussed in Section 4.0. The indicated statement blocks perform the following functions:

A. Read Input Data File. In this block, data sets are read one at a time. Only WET/DRY data (2xxxxx tests, 7 cards, required data on cards 4 and 5) and DRY data (3xxxxx tests, 5 cards, required data on the first card) are used with this program. After reading the proper data card values of Colburn j factor (XJ), Reynolds number (RE), test date (JDAT) and test identifier (IDNO) are placed in their matrices.

B. *Least Squares Summations*. The summations Σj and ΣRe are formed.

C. *Correlation Parameters*. The parameters C_2 and n in the correlation

$$j = C_2 R_e^n \tag{D-1}$$

are determined.

D. *Correlation Coefficient*. The correlation coefficient between j and Re is determined.

E. *Mean of j_i^*/j_i Determined*. The parameter $\overline{\phi} = (\Sigma j_i^*/j)/n$ is determined.

F. *Standard Estimate of Error*. The standard error of estimate and individual values of deviation are determined.

G. *Error of Each Data Set*. The error of estimate of each point, deviation divided by standard error of estimate, is computed for each data set.

H. *Printing*. Correlation results are printed.

I. *First Histogram*. The histogram of ϕ_i is formed.

J. *Second Histogram*. The histogram of σ_i is formed.

Table D-7 is a sample output from the code to correlate j with Re. The column headings are self-explanatory.

D.5. FAN EFFICIENCY CORRELATION CODE

Table D-8 is the computer code used to linearly correlate fan-stack-gear box-motor overall efficiency with airflow rate. The functions of the indicated statement blocks are as follows:

A. Read Input Data File. Since the desired fan data are on the fourth card in a given data set, this block reads one card, to see if all data have been read, skips two cards and reads the fan data. When the final data set has been read, the program proceeds to block B.

B. Least Squares. The program then calls a canned least squares routine to find the correlation coefficients C_3 and C_4.

C. The Correlation Coefficient. The correlation coefficient between fan system efficiency and air volume flow rate is determined.

D. ϕ_i and $\bar{\phi}$ Calculations. The program next computes the mean ratio of $\phi_i = \eta_i^*/\eta_i$ for the fan efficiency data file.

E. Standard Error of Estimate. Next the program determine the deviation $\phi_i - \bar{\phi}$ for each data set and computes the standard error of estimate.

F. Print. In the final statement block the results of the correlation are printed.

Table D-9 is a sample listing of the output from the fan efficiency correlation program.

TABLE D-1

EXAMPLES OF PUNCHED CARD OUTPUT FROM THE DATA REDUCTION PROGRAM (APPENDIX C) USED AS INPUT TO CORRELATION PROGRAMS

WET

```
113102 355  8.6232E+03 7.9250E+02 6.3898E+06 1.2887E+06 1.8476E+02 8.4988E-01
 3.8900E+01 8.8320E+01 3.1562E+01 8.7409E+01 8.9600E+01 8.1650E+01 7.9000E+01
 4.9895E-01-5.0990E-01
113102 355 5.8344E-02 5.9228E+05 6.6000E+01 1.2000E+01 5.6326E+01 2.7386E-01
 1.3080E-08 4.3586E-02 3.1991E-06 9.4078E-02
```

WET/DRY

```
211052  15  1.8778E+03 2.7336E+03 1.3914E+06 4.4451E+06 1.7978E+02 3.7977E+00
 7.8843E+01 6.8500E+01 1.2695E+01 6.5408E+01 9.3400E+01 5.8350E+01 7.5400E+01
 3.7738E+00-4.7850E+00
211052  15  1.7153E+03 2.9148E+01 2.3717E+01 1.5455E-02 4.4451E+06 4.0900E+01
 1.2695E+01 7.8843E+01 9.8500E+01 8.1100E+01 1.6276E+06 4.3081E+01
211052  15 1.4254E-01 1.9727E+06 9.0000E+01 1.2000E+01 9.3876E+01 6.6893E-01
 1.7185E-08 1.0646E-01 4.2031E-06 4.6608E-01
```

DRY

```
332185 226  1.0420E+03 1.1878E+01 9.1607E+00 9.9154E-03 2.8032E+06 7.8220E+01
 6.5288E+01 9.8686E+01 1.0580E+02 1.0280E+02 5.9609E+06-2.1389E+01
332185 226 2.8535E-01 1.2997E+06 1.2700E+02 1.2000E+01 1.8775E+02 3.1232E-01
 1.7277E-08 4.9708E-02 4.2256E-06 3.0613E-01
```

FAN

```
421042 310  4.0035E+03 1.4652E+03 2.9666E+06 2.3825E+06 9.0628E+01 8.9796E-01
 7.4443E+01 8.1890E+01 4.5586E+01 7.9401E+01 8.8100E+01 7.6650E+01 7.1100E+01
 1.2177E+00 2.9660E+01
421042 310 2.1999E-01 1.0703E+06 1.1300E+02 1.2000E+01 1.5020E+02 2.8907E-01
 1.6825E-08 4.6006E-02 4.1150E-06 2.4275E-01
```

TABLE D-2

LISTING OF THE MASS TRANSFER COEFFICIENT CORRELATION COMPUTER CODE

```
            PROGRAM KAPRO (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
            DIMENSION IRUN(750),XLTAB(750),GTAB(750),XKATAB(750),
           +XNTU(750),TABNTU(750),NDATA(750),AM(4,4),BM(4),XLUSE(750),
           +GUSE(750),XKAUSE(750),TEMP(750),XKALOG(750),GLOG(750),
           +XLLOG(750),TEMLOG(750),ANS(4),INO(750),NOS(40),NOE(40),
           +RAT(750),DEV(750),SIGMA(750),BOT(50),TOP(50),NIN(50),
           +TEMUSE(750),ERRTAB(750),NDAYTB(750),NDAY(750),ERR(750),
           +COMPKA(750),COMNTU(750)
            WRITE(6,500)
            WRITE(6,380)
            READ(5,550) NOSE,NOT,JSINB,RANGE,NERR,ERRMAX
     A      DO 100 I=1,NOSE,1
        100 READ(5,590) NOS(I),NOE(I)
            I = 1
         10 READ(5,20) IA,IB,IC,ID,IE,IF,IDAT,XA,XB,XC,XD,XE,XF
         20 FORMAT(6I1,1X,I3,1X,6E11.4)
            IF(EOF,5)13,15
         15 XLTAB(I) = XA
            GTAB(I) = XB
            XKATAB(I) = XE
            TABNTU(I) = XF
            NDAYTB(I) = IDAT
  B         READ(5,24) XA,XB,XC,XD,XE,XF,XG
         24 FORMAT(7E11.4)
            IF(NOT.EQ.1) GO TO 40
            IF(NOT-3)31,32,33
     C   31 TEMP(I) = XE
            GO TO 40
         32 TEMP(I) = XF
            GO TO 40
```

(Continued)

Table D-2 (cont'd)

```
         33 IF(NOT-5)34,35,36
         34 TEMP(I) = (XE+XF)/2.
            GO TO 40
         35 TEMP(I) = XA
   C        GO TO 40
         36 IF(NOT-7)37,38,39
         37 TEMP(I) = XB
            GO TO 40
         38 TEMP(I) = (XA+XB)/2.
 B          GO TO 40
         39 TEMP(I) = (XA+XB+XE+XF)/4.
         40 IRUN(I) = IA*100000+IB*10000+IC*1000+ID*100+IE*10+IF
            I = I+1
            READ(5,25)XA,XB
         25 FORMAT(2E11.4)
            ERRTAB(I) = XB
            IF(IA.EQ.7) GO TO 41
            IF(IA-2)41,42,43
         41 READ(5,21)
         21 FORMAT(/)
            GO TO 44
         42 READ(5,22)
         22 FORMAT(///)
            GO TO 44
         43 WRITE(6,23)
         23 FORMAT(10X,37HABORT CORRELATION. BAD CARD SEQUENCE.,//)
            GO TO 370
         44 CONTINUE
            GO TO 10
         13 NOP = I-1
 D          IF(NOT.NE.1) GO TO 110
            DO 120 I=1,NOP
        120 TEMP(I) = 1.
            WRITE(6,390)
 E          GO TO 121
        110 IF(NOT-3)111,112,113
```

(Continued)

Table D-2 (cont'd)

```
     111 WRITE(6,400)
         GO TO 121
     112 WRITE(6,401)
         GO TO 121
     113 IF(NOT-5)114,115,116
     114 WRITE(6,402)
         GO TO 121
E    115 WRITE(6,403)
         GO TO 121
     116 IF(NOT-7)117,118,119
     117 WRITE(6,404)
         GO TO 121
     118 WRITE(6,405)
         GO TO 121
     119 WRITE(6,406)
     121 N=0
         DO 130 I=1,NOSE,1
         MS = NOS(I)
         ME = NOE(I)
         DO 140 J=MS,ME
         N=N+1
     140 INO(N) = J
     130 CONTINUE
         NSUM = N
         DO 150 I=1,NSUM
         J = INO(I)
F        NDATA(I) = IRUN(J)
         NDAY(I) = NDAYTB(J)
         ERR(I) = ERRTAB(J)
         SA = XLTAB(J)
         SB = GTAB(J)
         SC = TEMP(J)
         XLUSE(I) = SA
         XNTU(I) = TABNTU(J)
         XLLOG(I) = ALOG(SA)
         GUSE(I) = SB
```

(Continued)

Table D-2 (cont'd)

```
          GLOG(I) = ALOG(SB)
          TEMLOG(I) = ALOG(SC)
F         TEMUSE(I) = SC
          SD = XKATAB(J)
          XKAUSE(I) = SD
      150 XKALOG(I) = ALOG(SD)
          IF(NERR.EQ.0) GO TO 180
          J=0
          DO 170 I=1,NSUM
          ERROR = XLUSE(I)
          ERROR = ABS(ERROR)
          IF(ERROR.GT.ERRMAX) GO TO 160
          J = J+1
          INO(J) = INO(I)
          NDATA(J) = NDATA(I)
          NDAY(J) = NDAY(I)
          ERR(J) = ERR(I)
G         XLUSE(J) = XLUSE(I)
          XNTU(J) = XNTU(I)
          XLLOG(J) = XLLOG(I)
          GUSE(J) = GUSE(I)
          GLOG(J) = GLOG(I)
          TEMLOG(J) = TEMLOG(I)
          TEMUSE(J) = TEMUSE(I)
          XKAUSE(J) = XKAUSE(I)
          XKALOG(J) = XKALOG(I)
      160 CONTINUE
      170 CONTINUE
          NSUM = J
      180 CONTINUE
          SW=0.
          SX=0.
          SZ=0.
H         SY=0.
          SXTWO=0.
          SWTWO=0.
```

(Continued)

Table D-2 (cont'd)

```
         SZTWO=0.
         SYTWO=0.
         SWX=0.
H        SWZ=0.
         SWY=0.
         SXZ=0.
         SXY=0.
         SZY=0.
         DO 340 I=1,NSUM,1
         WI=XLLOG(I)
         XI=GLOG(I)
         ZI=TEMLOG(I)
         YI=XKALOG(I)
         SW=SW+WI
         SX=SX+XI
         SZ=SZ+ZI
         SY=SY+YI
         SXTWO=SXTWO+XI*XI
I        SWTWO=SWTWO+WI*WI
         SZTWO=SZTWO+ZI*ZI
         SYTWO=SYTWO+YI*YI
         SWX=SWX+WI*XI
         SWZ=SWZ+WI*ZI
         SWY=SWY+WI*YI
         SXZ=SXZ+XI*ZI
         SXY=SXY+XI*YI
     340 SZY=SZY+ZI*YI
         FW = NSUM*SWTWO - SW**2
         FX = NSUM*SXTWO - SX**2
         FY = NSUM*SYTWO - SY**2
J        FZ = NSUM*SZTWO - SZ**2
         R12 = (NSUM*SWY-SW*SY)/(SQRT(FW*FY))
         R13 = (NSUM*SXY-SX*SY)/(SQRT(FX*FY))
         R14 = (NSUM*SZY-SZ*SY)/(SQRT(FZ*FY))
         R23 = (NSUM*SWX-SW*SX)/(SQRT(FX*FW))
         R24 = (NSUM*SWZ-SW*SZ)/(SQRT(FW*FZ))
         R34 = (NSUM*SXZ-SX*SZ)/(SQRT(FX*FZ))
```

(Continued)

Table D-2 (cont'd)

```
         IF(NOT.NE.1) GO TO 597
         R14 = 0.
   J     R24 = 0.
         R34 = 0.
     597 CONTINUE
         R23P4 = (R23-R24*R34)/(SQRT((1-R24**2)*(1-R34**2)))
         R12P4 = (R12-R14*R24)/(SQRT((1-R14**2)*(1-R24**2)))
         R13P4 = (R13-R14*R34)/(SQRT((1-R14**2)*(1-R34**2)))
   K     R12P34 = (R12P4-R13P4*R23P4)/(SQRT((1-R13P4**2)*(1-R23P4**2)))
         RHS = (1-R14**2)*(1-R13P4**2)*(1-R12P34**2)
         R1P234 = 1-RHS
         WRITE(6,599)R12,R13,R14
     599 FORMAT(///,28X,36HCORRELATION COEFFICIENT: KA WITH L =,F7.4,/,
        +28X,36HCORRELATION COEFFICIENT: KA WITH G =,F7.4,/,
        +28X,36HCORRELATION COEFFICIENT: KA WITH T =,F7.4)
         WRITE(6,598)R1P234,NSUM
     598 FORMAT(27X,39HCOEFFICIENT OF MULTIPLE DETERMINATION =,F7.4,/,
        +41X,13HSAMPLE SIZE =,I5,///)
         AM(1,1)=NSUM
         AM(1,2)=SW
         AM(1,3)=SX
         AM(1,4)=SZ
         AM(2,1)=SW
         AM(2,2)=SWTWO
         AM(2,3)=SWX
         AM(2,4)=SWZ
         AM(3,1)=SX
         AM(3,2)=SWX
   L     AM(3,3)=SXTWO
         AM(3,4)=SXZ
         AM(4,1)=SZ
         AM(4,2)=SWZ
         AM(4,3)=SXZ
         AM(4,4)=SZTWO
         BM(1)=SY
         BM(2)=SWY
```

(Continued)

Table D-2 (cont'd)

```
          BM(3)=SXY
          BM(4)=SZY
          NEQ=4
          IF (NOT.EQ.1) NEQ=3
L         CALL LINEQ1 (AM,BM,ANS,4,NEQ,1,NONO)
          IF (NONO.EQ.0) GO TO 350
          WRITE (6,530) NONO
          GO TO 370
      350 TEM=ANS(1)
          ANS(1) = EXP(TEM)
          COEFF = ANS(1)
M         A = ANS(2)
          B = ANS(3)
          C = ANS(4)
          IF(NOT.EQ.1) C = 0.
          SUM = 0.
          WRITE (6,480)
          WRITE (6,460)
          DO 360 I=1,NSUM,1
          XL=XLUSE(I)
N         G=GUSE(I)
          T=TEMUSE(I)
          COMPKA(I) = COEFF*(XL**A)*(G**B)*(T**C)
          COMNTU(I) = COMPKA(I)*39.667/XL
          RAT(I) = XKAUSE(I)/COMPKA(I)
      360 SUM = SUM + RAT(I)
          XBAR = SUM/NSUM
          SUM = 0.
          DO 361 I=1,NSUM
O         DEV(I) = ABS(RAT(I)-XBAR)
      361 SUM = SUM + DEV(I)**2
          STDDEV = SQRT(SUM/NSUM)
          DO 362 I=1,NSUM
      362 SIGMA(I) = DEV(I)/STDDEV
P         DO 363 I=1,NSUM
          XL = XLUSE(I)
```

(Continued)

Table D-2 (cont'd)

```
           G = GUSE(I)
           T = TEMUSE(I)
P          XKAP = COMPKA(I)
           XNTUP = COMNTU(I)
       363 WRITE(6,470)I,INO(I),NDATA(I),NDAY(I),XL,G,T,
          +XKAUSE(I),XKAP,RAT(I),XNTU(I),XNTUP,ERR(I),
          +SIGMA(I),DEV(I)
           WRITE(6,600) STDDEV,XBAR
           DELJ = RANGE/JSINB
           DO 364 J=1,JSINB
           BOT(J) = DELJ*(J-1)
       364 TOP(J) = DELJ*J
Q          DO 369 J=1,JSINB
       369 NIN(J) = 0
           DO 367 I=1,NSUM
           TEST = RAT(I)
           DO 366 J=1,JSINB
           JS = J
       366 IF(TEST.GE.BOT(J).AND.TEST.LT.TOP(J)) GO TO 371
       371 NIN(JS) = NIN(JS)+1
       367 CONTINUE
           WRITE(6,620)
           DO 368 J=1,JSINB
       368 WRITE(6,630)J,BOT(J),TOP(J),NIN(J)
           WRITE(6,670)
       670 FORMAT(/////,39X,23HHISTOGRAM OF SIGMA DATA,//,39X,1HJ,4X,
R         +3HBOT,5X,3HTOP,6X,1HN,/)
           DO 375 J=1,JSINB
       375 NIN(J) = 0
           DO 376 I=1,NSUM
           TEST = SIGMA(I)
           DO 377 J=1,JSINB
           JS = J
       377 IF(TEST.GE.BOT(J).AND.TEST.LT.TOP(J)) GO TO 378
           GO TO 379
       378 NIN(JS) = NIN(JS) + 1
```

(Continued)

Table D-2 (cont'd)

```
      379 CONTINUE
      376 CONTINUE
R         DO 381 J=1,JSINB
      381 WRITE(6,630)J,BOT(J),TOP(J),NIN(J)
      460 FORMAT(3X,1HI,3X,2HNO,4X,3HRUN,3X,3HDAY,4X,1HL,6X,1HG,5X,1HT,6X,
         +3HKAD,4X,3HKAC,4X,3HRAT,3X,4HNTUD,3X,4HNTUC,3X,3HERR,3X,5HSIGMA,3X,
         +3HDEV)
      470 FORMAT(1X,I4,1X,I4,1X,I6,2X,I3,2X,F6.0,1X,F5.0,1X,F6.2,1X,F6.1,1X,
         +F6.1,1X,F6.3,1X,F6.3,1X,F6.3,1X,F6.1,1X,F6.3,1X,F6.3)
      600 FORMAT(///,34X,9HSTDDEV = ,F6.3,4X,9HAVGRAT = ,F6.3)
      620 FORMAT(///,37X,26HHISTOGRAM OF KA RATIO DATA,//,39X,1HJ,4X,
         +3HBOT,5X,3HTOP,6X,1HN,/)
      630 FORMAT(37X,I4,2X,F6.3,2X,F6.3,2X,I4)
          WRITE(6,490) ANS(1),ANS(2),ANS(3),C
      370 STOP
    C
      380 FORMAT(///,32X,37HCORRELATION OF TVA COOLING TOWER DATA,//,38X,
         +25HMASS TRANSFER COEFFICIENT,///,37X,27HKA = D*(L**A)*(G**B)*(T**C
         +),///)
      390 FORMAT(33X,35HCORRELATION BASED ON NO TEMPERATURE,//)
      400 FORMAT(32X,37HCORRELATION BASED ON INLET WATER TEMP,//)
      401 FORMAT(32X,36HCORRELATION BASED ON EXIT WATER TEMP,//)
      402 FORMAT(33X,35HCORRELATION BASED OF AVG WATER TEMP,//)
      403 FORMAT(33X,35HCORRELATION BASED OF INLET AIR TEMP,//)
      404 FORMAT(32X,36HCORRELATION BASED ON OUTLET AIR TEMP,//)
      405 FORMAT(34X,33HCORRELATION BASED ON AVG AIR TEMP,//)
      406 FORMAT(33X,35HCORRELATION BASED ON AVG FLUID TEMP,//)
      480 FORMAT(//,40X,22HRESULTS OF CORRELATION,//)
      490 FORMAT (//,40X,22HCORRELATION PARAMETERS,//,44X,5HCO = ,F10.8,/,44
         +X,5HA  = ,F10.5,/,44X,5HB  = ,F10.5,/,44X,5HC  = ,F10.5)
      500 FORMAT(1H1)
      530 FORMAT(//,15X,7HNONO = ,I6,//)
      550 FORMAT(I3,I3,I3,F6.3,I2,F7.0)
      590 FORMAT(1X,I3,1X,I3)
    C
          END
```

TABLE D-3

SAMPLE OUTPUT FROM THE MASS TRANSFER COEFFICIENT CORRELATION CODE

```
                          CORRELATION OF TVA COOLING TOWER DATA
                              MASS TRANSFER COEFFICIENT

                            KA = D*(L**A)*(G**B)*(T**C)

                         CORRELATION BASED ON NO TEMPERATURE

                    CORRELATION COEFFICIENT: KA WITH L =  .4075
                    CORRELATION COEFFICIENT: KA WITH G =  .9137
                    CORRELATION COEFFICIENT: KA WITH T =      0
                   COEFFICIENT OF MULTIPLE DETERMINATION = .69733
                               SAMPLE SIZE =  167

                              RESULTS OF CORRELATION

  I   NO    RUN   DAY    L      G     T      KAD     KAC    RAT   NTUD   NTUC  IERR  SIGMA   DEV
  1  173  121011  125  4011.   337.  1.00    38.4    38.4   .599   .379   .379    0   .049   .004
  2  174  121012  125  4012.   393.  1.00    49.9    43.6  1.140   .499   .431    0  1.665   .142
  3  175  121013  125  4013.   380.  1.00    47.3    42.4  1.117   .468   .419    0  1.331   .113
  4  176  121014  125  4013.   427.  1.00    54.0    46.7  1.157   .538   .462    0  1.799   .153
  5  177  121021  125  4008.   657.  1.00    63.9    66.5   .961   .633   .658    0   .501   .043
  6  178  121022  125  4009.   666.  1.00    65.5    67.2   .974   .648   .665    0   .343   .029
  7  179  121023  125  4010.   684.  1.00    66.2    68.7   .564   .655   .680    0   .471   .040
  8  180  121024  125  4009.   696.  1.00    69.0    69.8   .589   .683   .690    0   .173   .015
  9  181  121031  125  4009.  1226.  1.00   113.4   111.2  1.020  1.122  1.100    0   .197   .017
 10  182  121032  125  4010.  1300.  1.00   120.0   117.3  1.023  1.187  1.160    0   .228   .019
 11  183  121033  125  4010.  1324.  1.00   121.1   118.5  1.022  1.198  1.172    0   .219   .019
 12  184  121034  125  4010.  1240.  1.00   113.2   112.2  1.009  1.119  1.110    0   .058   .005
 13  185  121041  128  5507.   267.  1.00    39.3    40.0   .982   .283   .288    0   .249   .021
 14  186  121061  128  5507.  1269.  1.00   160.5   144.1  1.114  1.156  1.038    0  1.302   .111
 15  187  121062  128  5507.  1314.  1.00   161.8   148.3  1.091  1.165  1.068    0  1.027   .087
 16  188  121063  128  5507.  1370.  1.00   167.4   153.4  1.092  1.206  1.105    0  1.035   .088
 17  189  121064  128  5508.  1343.  1.00   162.6   150.9  1.077  1.171  1.087    0   .867   .074
 18  190  121071  128  6055.   333.  1.00    51.8    51.3  1.010   .339   .336    0   .075   .006
 19  191  121072  128  6054.   349.  1.00    56.1    53.3  1.052   .367   .349    0   .564   .048
 20  192  121073  128  6054.   352.  1.00    58.0    53.7  1.079   .380   .352    0   .887   .076
 21  193  121074  128  6053.   355.  1.00    57.2    54.0  1.058   .375   .354    0   .638   .054
 22  194  121091  128  6722.  1400.  1.00   192.6   180.5  1.067  1.137  1.065    0   .745   .063
 23  195  121092  128  6722.  1452.  1.00   195.4   185.9  1.051  1.153  1.097    0   .558   .047
 24  196  121093  128  6722.  1459.  1.00   195.8   186.2  1.051  1.155  1.099    0   .561   .048
 25  197  121094  128  6721.  1421.  1.00   192.6   182.7  1.054  1.137  1.078    0   .594   .051
 26  198  121101  129  8128.   393.  1.00    58.0    72.8   .797   .283   .355    0  2.429   .207
 27  199  121102  129  8124.   405.  1.00    61.9    74.7   .829   .302   .365    0  2.054   .175
 28  200  121103  129  8123.   393.  1.00    64.3    72.8   .883   .314   .356    0  1.416   .121
```

(Continued)

Table D-3 (cont'd)

90	262	123033	130	4002.	1576.	1.00	127.6	136.5	.935	1.265	1.353	0	.806	.069
91	263	123034	130	4002.	1598.	1.00	129.9	138.0	.941	1.288	1.368	0	.737	.063
92	264	123041	132	5505.	335.	1.00	51.7	48.1	1.074	.373	.347	0	.822	.070
93	265	123042	132	5505.	325.	1.00	49.8	47.0	1.059	.358	.339	0	.650	.055
94	266	123043	132	5505.	360.	1.00	55.5	51.0	1.088	.400	.368	0	.994	.085
95	267	123044	132	5506.	342.	1.00	53.9	49.0	1.100	.388	.353	0	1.137	.097
96	268	123051	131	5483.	502.	1.00	69.5	66.9	1.039	.503	.484	0	.410	.035
97	269	123052	131	5481.	516.	1.00	72.6	68.4	1.061	.526	.495	0	.678	.058
98	270	123053	131	5481.	517.	1.00	74.4	68.5	1.086	.539	.496	0	.972	.083
99	271	123054	131	5481.	551.	1.00	77.0	72.3	1.066	.558	.523	0	.734	.062
100	272	123061	131	5475.	1102.	1.00	130.6	127.7	1.023	.946	.925	0	.226	.019
101	273	123062	131	5480.	1088.	1.00	128.9	126.5	1.019	.933	.916	0	.186	.016
102	274	123063	131	5474.	1158.	1.00	142.4	132.9	1.071	1.032	.963	0	.789	.067
103	275	123064	131	5475.	1137.	1.00	139.0	131.0	1.061	1.007	.949	0	.676	.058
104	276	123071	137	6734.	398.	1.00	66.0	64.2	1.028	.389	.378	0	.285	.024
105	277	123072	137	6734.	415.	1.00	70.3	66.4	1.059	.414	.391	0	.645	.055
106	278	123073	137	6734.	374.	1.00	63.3	61.0	1.038	.373	.360	0	.400	.034
107	279	123074	137	6733.	344.	1.00	60.4	56.9	1.062	.356	.335	0	.684	.058
108	280	123081	137	6715.	650.	1.00	106.9	95.9	1.115	.631	.566	0	1.306	.111
109	281	123082	137	6717.	700.	1.00	116.9	101.9	1.147	.690	.602	0	1.682	.143
110	282	123083	137	6718.	738.	1.00	107.2	106.5	1.006	.633	.629	0	.032	.003
111	283	123084	137	6718.	725.	1.00	116.7	104.9	1.112	.689	.620	0	1.275	.108
112	284	123092	137	6724.	1203.	1.00	185.3	159.3	1.163	1.093	.940	0	1.873	.159
113	285	123093	137	6725.	1397.	1.00	203.9	180.3	1.131	1.203	1.063	0	1.497	.127
114	286	123094	137	6725.	1365.	1.00	194.7	176.8	1.101	1.148	1.043	0	1.147	.098
115	287	123101	137	8079.	425.	1.00	77.8	77.4	1.005	.382	.380	0	.017	.001
116	288	123102	137	8078.	466.	1.00	80.9	83.4	.970	.397	.409	0	.395	.034
117	289	123103	137	8078.	430.	1.00	77.1	78.1	.987	.379	.384	0	.191	.016
118	290	123104	137	8078.	456.	1.00	78.9	81.9	.963	.387	.402	0	.475	.040
119	291	123111	138	8090.	744.	1.00	117.6	122.7	.958	.577	.602	0	.534	.045
120	292	123112	138	8091.	766.	1.00	121.6	125.8	.967	.596	.617	0	.429	.037
121	293	123113	138	8091.	732.	1.00	120.3	121.2	.993	.590	.594	0	.125	.011
122	294	123114	138	8090.	830.	1.00	101.0	134.3	.752	.495	.659	0	2.958	.252
123	295	123121	136	8073.	1389.	1.00	213.0	204.9	1.040	1.047	1.007	0	.424	.036
124	296	123122	136	8091.	1508.	1.00	218.6	219.5	.996	1.072	1.076	0	.089	.008
125	297	123123	136	8072.	1393.	1.00	213.6	205.3	1.040	1.050	1.009	0	.431	.037
126	298	123124	136	8089.	1484.	1.00	222.4	216.7	1.027	1.091	1.062	0	.271	.023
127	299	124011	130	4017.	364.	1.00	39.0	41.0	.951	.385	.405	0	.617	.052
128	300	124013	130	4017.	404.	1.00	41.9	44.6	.940	.414	.441	0	.745	.063
129	301	124014	130	4016.	419.	1.00	42.6	46.0	.926	.421	.454	0	.916	.078
130	302	124021	130	4000.	812.	1.00	68.8	79.1	.870	.682	.784	0	1.573	.134
131	303	124022	130	4000.	752.	1.00	67.0	74.2	.902	.664	.736	0	1.193	.102
132	304	124023	130	4000.	727.	1.00	64.7	72.2	.897	.642	.716	0	1.258	.107
133	305	124024	130	4000.	759.	1.00	66.2	74.8	.885	.656	.741	0	1.390	.118
134	306	124031	131	4007.	1430.	1.00	125.1	126.1	.992	1.238	1.249	0	.141	.012
135	307	124032	131	4007.	1441.	1.00	124.7	126.9	.983	1.235	1.256	0	.242	.021
136	308	124033	131	4007.	1404.	1.00	122.2	124.2	.984	1.210	1.230	0	.236	.020
137	309	124114	138	8050.	780.	1.00	123.0	127.1	.968	.606	.626	0	.418	.036
138	310	124121	139	8082.	1696.	1.00	224.0	241.6	.927	1.099	1.186	0	.900	.077
139	311	124122	139	8059.	1802.	1.00	236.4	253.4	.933	1.163	1.247	0	.833	.071
140	312	124123	139	8058.	1747.	1.00	230.2	247.0	.932	1.133	1.216	0	.842	.072
141	313	124124	139	8055.	1626.	1.00	226.8	232.7	.974	1.117	1.146	0	.344	.029
142	314	124034	131	4007.	1320.	1.00	107.2	118.0	.908	1.061	1.169	0	1.125	.096
143	315	124042	132	5503.	275.	1.00	43.4	40.9	1.062	.313	.295	0	.682	.058
144	316	124043	132	5503.	314.	1.00	49.5	45.6	1.085	.357	.329	0	.959	.082
145	317	124051	132	5492.	561.	1.00	77.1	73.4	1.050	.557	.530	0	.550	.047
146	318	124052	132	5492.	542.	1.00	76.5	71.3	1.073	.553	.515	0	.815	.069
147	319	124053	132	5490.	640.	1.00	83.1	81.8	1.016	.601	.591	0	.146	.012
148	320	124054	132	5489.	672.	1.00	70.9	65.1	1.068	.657	.615	0	.752	.064
149	321	124071	139	6769.	387.	1.00	52.7	62.9	.837	.309	.369	0	1.956	.166
150	322	124072	139	6769.	351.	1.00	55.6	58.1	.957	.326	.340	0	.544	.046

(Continued)

Table D-3 (cont'd)

29	201	121104	129	8122.	407.	1.00	63.9	74.9	.853	.312	.366	0	1.767	.150
30	202	121111	129	8108.	724.	1.00	115.6	120.2	.962	.566	.588	0	.487	.041
31	203	121112	129	8107.	746.	1.00	113.6	123.1	.922	.556	.602	0	.955	.081
32	204	121113	129	8107.	733.	1.00	113.2	121.4	.933	.559	.594	0	.833	.071
33	205	121114	129	8108.	753.	1.00	114.6	124.2	.923	.561	.608	0	.353	.081
34	206	121121	129	8103.	1554.	1.00	220.3	225.3	.978	1.078	1.103	0	.306	.026
35	207	121122	129	8104.	1574.	1.00	214.1	227.6	.941	1.048	1.114	0	.741	.063
36	208	121123	129	8103.	1565.	1.00	212.8	226.6	.939	1.041	1.109	0	.759	.065
37	209	121124	129	8103.	1640.	1.00	216.5	235.5	.919	1.060	1.153	0	.972	.084
38	210	122011	129	4007.	358.	1.00	36.2	40.3	.898	.358	.399	0	1.239	.105
39	211	122012	129	4006.	393.	1.00	43.1	43.5	.990	.427	.431	0	.163	.014
40	212	122013	129	4005.	384.	1.00	42.5	42.7	.996	.421	.423	0	.090	.008
41	213	122014	129	4004.	399.	1.00	38.8	44.0	.881	.384	.436	0	1.445	.123
42	214	122021	130	4012.	766.	1.00	71.9	75.5	.952	.711	.747	0	.604	.051
43	215	122022	130	4012.	765.	1.00	72.2	75.5	.956	.714	.746	0	.555	.047
44	216	122023	130	4010.	784.	1.00	73.1	77.0	.950	.723	.761	0	.632	.054
45	217	122024	130	4011.	724.	1.00	64.9	72.1	.901	.642	.713	0	1.205	.103
46	218	122031	130	4003.	1541.	1.00	128.5	134.0	.959	1.274	1.328	0	.523	.044
47	219	122032	130	4004.	1568.	1.00	130.3	136.0	.958	1.291	1.347	0	.533	.045
48	220	122033	130	4004.	1590.	1.00	136.4	137.5	.992	1.352	1.362	0	.134	.011
49	221	122034	130	4004.	1519.	1.00	121.7	132.5	.918	1.205	1.313	0	1.002	.085
50	222	122041	132	5510.	278.	1.00	44.8	41.2	1.086	.322	.297	0	.966	.082
51	223	122042	132	5507.	331.	1.00	50.7	47.6	1.065	.365	.343	0	.725	.062
52	224	122043	132	5508.	335.	1.00	49.2	48.1	1.023	.355	.347	0	.227	.019
53	225	122043	132	5506.	354.	1.00	50.2	50.3	.997	.362	.363	0	.072	.006
54	226	122051	131	5481.	556.	1.00	85.2	72.8	1.171	.617	.527	0	1.969	.168
55	227	122052	131	5483.	527.	1.00	85.1	69.6	1.222	.615	.504	0	2.564	.218
56	228	122053	131	5485.	533.	1.00	88.8	70.3	1.264	.642	.508	0	3.053	.260
57	229	122054	131	5486.	552.	1.00	83.1	72.3	1.140	.601	.523	0	1.700	.145
58	230	122061	131	5482.	1185.	1.00	133.8	135.7	.986	.969	.982	0	.204	.017
59	231	122062	131	5481.	1159.	1.00	137.6	133.2	1.032	.976	.964	0	.339	.029
60	232	122063	131	5481.	1226.	1.00	139.5	139.5	1.000	1.010	1.010	0	.043	.004
61	233	122064	131	5481.	1211.	1.00	143.5	138.1	1.040	1.039	.999	0	.424	.036
62	234	122071	136	6756.	370.	1.00	65.6	60.6	1.082	.305	.356	0	.918	.078
63	235	122072	136	6756.	349.	1.00	63.0	57.7	1.092	.370	.339	0	1.035	.088
64	236	122073	136	6757.	374.	1.00	66.9	61.2	1.093	.392	.359	0	1.052	.090
65	237	122074	136	6757.	359.	1.00	63.3	59.1	1.078	.372	.347	0	.807	.069
66	238	122081	136	6749.	664.	1.00	111.5	97.9	1.139	.655	.576	0	1.586	.135
67	239	122082	136	6749.	698.	1.00	111.5	102.0	1.093	.655	.600	0	1.047	.089
68	240	122083	136	6749.	650.	1.00	101.7	96.2	1.057	.598	.566	0	.627	.053
69	241	122084	136	6749.	548.	1.00	96.8	83.7	1.157	.569	.492	0	1.799	.153
70	242	122091	136	6744.	1344.	1.00	189.3	174.9	1.082	1.113	1.029	0	.920	.078
71	243	122092	136	6744.	1391.	1.00	210.9	179.9	1.172	1.240	1.058	0	1.978	.168
72	244	122093	136	6744.	1336.	1.00	182.1	174.1	1.046	1.071	1.024	0	.494	.042
73	245	122094	136	6745.	1370.	1.00	204.4	177.8	1.150	1.202	1.046	0	1.718	.146
74	246	122101	136	8116.	348.	1.00	63.2	65.8	.961	.309	.322	0	.505	.043
75	247	122102	136	8115.	378.	1.00	67.1	70.5	.952	.320	.345	0	.602	.051
76	248	122121	136	8088.	1410.	1.00	211.3	207.6	1.018	1.036	1.018	0	.166	.014
77	249	122122	136	8103.	1475.	1.00	215.5	215.8	.999	1.055	1.056	0	.056	.005
78	250	122123	136	8100.	1566.	1.00	216.0	226.7	.953	1.058	1.110	0	.597	.051
79	251	122124	136	8094.	1386.	1.00	199.6	204.8	.975	.978	1.004	0	.339	.029
80	252	123011	130	4018.	346.	1.00	36.8	39.3	.938	.364	.388	0	.769	.065
81	253	123012	130	4018.	332.	1.00	35.5	37.9	.936	.351	.375	0	.789	.067
82	254	123013	130	4017.	348.	1.00	36.4	39.5	.924	.360	.390	0	.941	.080
83	255	123014	130	4017.	361.	1.00	39.2	40.7	.964	.387	.402	0	.460	.039
84	256	123021	130	4003.	791.	1.00	71.7	77.4	.926	.710	.767	0	.914	.078
85	257	123022	130	4003.	767.	1.00	69.4	75.5	.920	.688	.748	0	.988	.084
86	258	123023	130	4004.	780.	1.00	73.7	76.5	.964	.731	.758	0	.471	.040
87	259	123024	130	4003.	848.	1.00	77.6	82.0	.997	.769	.812	0	.671	.057
88	260	123031	130	4002.	1542.	1.00	121.1	134.1	.903	1.201	1.329	0	1.179	.100
89	261	123032	130	4002.	1572.	1.00	121.7	136.2	.894	1.206	1.350	0	1.292	.110

(Continued)

Table D-3 (cont'd)

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151  323 124073  139  6769.  370.  1.00   60.6   60.6   .997   .355   .355   0   .056  .005
152  324 124074  139  6768.  358.  1.00   61.3   59.0  1.040   .360   .346   0   .425  .036
153  325 124081  139  6755.  702.  1.00  103.7  102.6  1.010   .609   .603   0   .078  .007
154  326 124082  139  6754.  682.  1.00  103.2  100.2  1.029   .606   .589   0   .302  .026
155  327 124083  139  6754.  701.  1.00  107.0  102.6  1.043   .628   .602   0   .462  .039
156  328 124084  139  6754.  689.  1.00  104.2  101.0  1.032   .612   .593   0   .333  .028
157  329 124091  139  6746. 1438.  1.00  188.8  184.9  1.021  1.110  1.087   0   .204  .017
158  330 124092  139  6745. 1474.  1.00  188.4  188.8   .998  1.108  1.110   0   .064  .005
159  331 124093  139  6745. 1472.  1.00  186.7  188.5   .990  1.098  1.109   0   .156  .013
160  332 124094  139  6744. 1450.  1.00  188.1  186.2  1.011  1.106  1.095   0   .081  .007
161  333 124101  138  8073.  416.  1.00   62.9   75.9   .829   .309   .373   0  2.053  .179
162  334 124102  138  8070.  413.  1.00   64.0   75.5   .848   .315   .371   0  1.829  .156
163  335 124103  138  8070.  347.  1.00   53.5   65.4   .818   .263   .322   0  2.186  .186
164  336 124104  138  8072.  340.  1.00   54.6   64.4   .848   .268   .316   0  1.826  .155
165  337 124111  138  8050.  710.  1.00  106.3  117.7   .903   .524   .580   0  1.179  .100
166  338 124112  138  8049.  660.  1.00  106.9  110.8   .964   .527   .546   0   .462  .039
167  339 124113  138  8050.  673.  1.00  111.2  112.5   .988   .548   .554   0   .181  .015

                 STDDEV =    .085     AVGRAT =  .96004

                   HISTOGRAM OF KA RATIO DATA

                       DOT      PROP        N

                        1       0       .100    0
                        2     .100      .200    0
                        3     .200      .300    0
                        4     .300      .400    0
                        5     .400      .500    0
                        6     .500      .600    0
                        7     .600      .700    0
                        8     .700      .800    2
                        9     .800      .900   14
                       10     .900     1.000   10
                       11    1.000     1.100   17
                       12    1.100     1.200   17
                       13    1.200     1.300    2
                       14    1.300     1.400    0
                       15    1.400     1.500    0
                       16    1.500     1.600    0
                       17    1.600     1.700    0
                       18    1.700     1.800    0
                       19    1.800     1.900    0
                       20    1.900     2.000    0
                       21    2.000     2.100    0
                       22    2.100     2.200    0
                       23    2.200     2.300    0
                       24    2.300     2.400    0
                       25    2.400     2.500    0
                       26    2.500     2.600    0
                       27    2.600     2.700    0
                       28    2.700     2.800    0
                       29    2.800     2.900    0
                       30    2.900     3.000    0
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(Continued)

Table D-3 (cont'd)

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                HISTOGRAM OF SIGMA DATA
         J      BOT       TOP        N

         1         0      .100      14
         2      .100      .200      12
         3      .200      .300      11
         4      .300      .400       8
         5      .400      .500      16
         6      .500      .600      13
         7      .600      .700      13
         8      .700      .800      11
         9      .800      .900      10
        10      .900     1.000      13
        11     1.000     1.100       6
        12     1.100     1.200       6
        13     1.200     1.300       5
        14     1.300     1.400       4
        15     1.400     1.500       3
        16     1.500     1.600       2
        17     1.600     1.700       3
        18     1.700     1.800       4
        19     1.800     1.900       3
        20     1.900     2.000       3
        21     2.000     2.100       2
        22     2.100     2.200       1
        23     2.200     2.300       0
        24     2.300     2.400       0
        25     2.400     2.500       1
        26     2.500     2.600       1
        27     2.600     2.700       0
        28     2.700     2.800       0
        29     2.800     2.900       1
        30     2.900     3.000       1

             CORRELATION PARAMETERS

               CQ =  .00076997
               A  =     .72655
               B  =     .02300
               C  =          0
```

TABLE D-4

LISTING OF THE WATER LOSS CORRELATION COMPUTER CODE

```
        PROGRAM MASPRO (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
        DIMENSION IRUN(750),XLTAB(750),GTAB(750),XMATAB(750),
       +NDATA(750),AM(4,4),BM(4),XLUSE(750),
       +GUSE(750),XMAUSE(750),TEMP(750),XMALOG(750),GLOG(750),
       +XLLOG(750),TEMLOG(750),ANS(4),INO(750),NOS(40),NOE(40),
       +RAT(750),DEV(750),SIGMA(750),BOT(50),TOP(50),NIN(50),
       +TEMUSE(750),ERRTAB(750),NDAYTB(750),NDAY(750),ERR(750),
       +COMPMA(750)
        WRITE(6,500)
        WRITE(6,380)
        READ(5,550) NOSE,NOT,JSINB,RANGE,NERR,ERRMAX
  A     DO 100 I=1,NOSE,1
    100 READ(5,590) NOS(I),NOE(I)
        I = 1
     10 READ(5,20) IA,IB,IC,ID,IE,IF,IDAT,XA,XB,XC,XD,XE,XF
     20 FORMAT(6I1,1X,I3,1X,6E11.4)
        IF(EOF,5)13,15
     15 XLTAB(I) = XA
        GTAB(I) = XB
        NDAYTB(I) = IDAT
        READ(5,24) XA,XB,XC,XD,XE,XF,XG
     24 FORMAT(7E11.4)
        IF(NOT-2)30,31,32
     30 TEMP(I) = 1.
        GO TO 40
B  C 31 WFWI = SATHUM(XE,14.696)
        WFWO = SATHUM(XF,14.696)
        WFAI = SATHUM(XC,14.696)
        WFAO = SATHUM(XD,14.696)
        XLMWD = ((WFWI-WFAO)-(WFWO-WFAI))/ALOG((WFWI-WFAO)/(WFWO-WFAI))
```

(Continued)

Table D-4 (cont'd)

```
              TEMP(I) = XLMWD
              GO TO 40
           32 IF(NOT-4) 33,34,35
           33 T1 = XE
              T2 = XC
              GO TO 39
           34 T1 = XF
              T2 = XD
              GO TO 39
           35 IF(NOT-6)36,37,38
     C     36 T1 = XE
              T2 = XD
              GO TO 39
           37 T1 = XF
              T2 = XC
              GO TO 39
  B        38 T1 = (XE+XF)/2.
              T2 = (XC+XD)/2.
           39 CONTINUE
              W1 = SATHUM(T1,14.696)
              W2 = SATHUM(T2,14.696)
              TEMP(I) = ABS(W1-W2)
           40 READ(5,25)XA,XB
           25 FORMAT(2E11.4)
              ERRTAB(I) = XB
              XMATAB(I) = XA
              IRUN(I) = IA*100000+IB*10000+IC*1000+ID*100+IE*10+IF
              I = I + 1
              IF(IA.EQ.7) GO TO 41
              IF(IA-2)41,42,43
           41 READ(5,21)
           21 FORMAT(/)
              GO TO 10
           42 READ(5,22)
           22 FORMAT(///)
              GO TO 10
           43 WRITE(6,23)
```

(Continued)

Table D-4 (cont'd)

D

```
   23 FORMAT(10X,36HABORT CORRLATION. BAD CARD SEQUENCE.,//)
      GO TO 370
   13 NOP = I-1
      IF(NOT-2)50,51,52
   50 WRITE(6,60)
   60 FORMAT(33X,33HCORRELATION BASED SIMPLY ON WATER,/,
     +37X,25HAND AIR LOADINGS, L AND G,//)
      GO TO 70
   51 WRITE(6,61)
   61 FORMAT(31X,38HCORRELATION BASED ON LOG MEAN HUMIDITY,/,
     +32X,36HDIFFERENCE BETWEEN WATER AND AIR DEW,/,
     +41X,18HPOINT TEMPERATURES,//)
      GO TO 70
   52 IF(NOT-4)53,54,55
   53 WRITE(6,63)
   63 FORMAT(30X,40HCORRELATION BASED ON HUMIDITY DIFFERENCE,/,
     +31X,38HBETWEEN ENTERING WATER TEMPERATURE AND,/,
     +33X,34HENTERING AIR DEW POINT TEMPERATURE,//)
      GO TO 70
   54 WRITE(6,64)
   64 FORMAT(30X,40HCORRELATION BASED ON HUMIDITY DIFFERENCE,/,
     +31X,37HBETWEEN LEAVING WATER TEMPERATURE AND,/,
     +33X,33HLEAVING AIR DEW POINT TEMPERATURE,//)
      GO TO 70
   55 IF(NOT-6)56,57,58
   56 WRITE(6,66)
   66 FORMAT(30X,40HCORRELATION BASED ON HUMIDITY DIFFERENCE,/,
     +31X,38HBETWEEN ENTERING WATER TEMPERATURE AND,/,
     +33X,33HLEAVING AIR DEW POINT TEMPERATURE,//)
      GO TO 70
   57 WRITE(6,67)
   67 FORMAT(30X,40HCORRELATION BASED ON HUMIDITY DIFFERENCE,/,
     +31X,37HBETWEEN LEAVING WATER TEMPERATURE AND,/,
     +33X,34HENTERING AIR DEW POINT TEMPERATURE,//)
      GO TO 70
   58 WRITE(6,68)
   68 FORMAT(30X,40HCORRELATION BASED ON HUMIDITY DIFFERENCE,/,
```

(Continued)

Table D-4 (cont'd)

```
         +31X,37HBETWEEN AVERAGE WATER TEMPERATURE AND,/,
D        +33X,33HAVERAGE AIR DEW POINT TEMPERATURE,//)
      70 CONTINUE
     121 N=0
         DO 130 I=1,NOSE,1
         MS = NOS(I)
         ME = NOE(I)
         DO 140 J=MS,ME
         N = N+1
     140 INO(N) = J
     130 CONTINUE
         NSUM = N
         DO 150 I=1,NSUM
         J = INO(I)
         NDATA(I) = IRUN(J)
E        NDAY(I) = NDAYTB(J)
         ERR(I) = ERRTAB(J)
         SA = XLTAB(J)
         SB = GTAB(J)
         SC = TEMP(J)
         XLUSE(I) = SA
         XLLOG(I) = ALOG(SA)
         GUSE(I) = SB
         GLOG(I) = ALOG(SB)
         TEMLOG(I) = ALOG(SC)
         TEMUSE(I) = SC
         SD = XMATAB(J)
         XMAUSE(I) = SD
     150 XMALOG(I) = ALOG(SD)
         IF(NERR.EQ.0) GO TO 180
         J=0
         DO 170 I=1,NSUM
         ERROR = XLUSE(I)
F        ERROR = ABS(ERROR)
         IF(ERROR.GT.ERRMAX) GO TO 160
         J = J+1
```

(Continued)

Table D-4 (cont'd)

```
            INO(J) = INO(I)
            NDATA(J) = NDATA(I)
            NDAY(J) = NDAY(I)
            ERR(J) = ERR(I)
            XLUSE(J) = XLUSE(I)
            XLLOG(J) = XLLOG(I)
  F         GUSE(J) = GUSE(I)
            GLOG(J) = GLOG(I)
            TEMLOG(J) = TEMLOG(I)
            TEMUSE(J) = TEMUSE(I)
            XMAUSE(J) = XMAUSE(I)
            XMALOG(J) = XMALOG(I)
        160 CONTINUE
        170 CONTINUE
            NSUM = J
        180 CONTINUE
            SW=0.
            SX=0.
            SZ=0.
            SY=0.
            SXTWO=0.
            SWTWO=0.
            SZTWO=0.
  G         SYTWO = 0.
            SWX=0.
            SWZ=0.
            SWY=0.
            SXZ=0.
            SXY=0.
            SZY=0.
            DO 340 I=1,NSUM,1
            WI=XLLOG(I)
  H         XI=GLOG(I)
            ZI=TEMLOG(I)
            YI=XMALOG(I)
            SW=SW+WI
```

(Continued)

Table D-4 (cont'd)

```
           SX=SX+XI
           SZ=SZ+ZI
           SY=SY+YI
           SXTWO=SXTWO+XI*XI
           SWTWO=SWTWO+WI*WI
  H        SZTWO=SZTWO+ZI*ZI
           SYTWO=SYTWO+YI*YI
           SWX=SWX+WI*XI
           SWZ=SWZ+WI*ZI
           SWY=SWY+WI*YI
           SXZ=SXZ+XI*ZI
           SXY=SXY+XI*YI
      340  SZY=SZY+ZI*YI
           FW = NSUM*SWTWO - SW**2
           FX = NSUM*SXTWO - SX**2
           FY = NSUM*SYTWO - SY**2
           FZ = NSUM*SZTWO - SZ**2
           R12 = (NSUM*SWY-SW*SY)/(SQRT(FW*FY))
           R13 = (NSUM*SXY-SX*SY)/(SQRT(FX*FY))
  I        R14 = (NSUM*SZY-SZ*SY)/(SQRT(FZ*FY))
           R23 = (NSUM*SWX-SW*SX)/(SQRT(FX*FW))
           R24 = (NSUM*SWZ-SW*SZ)/(SQRT(FW*FZ))
           R34 = (NSUM*SXZ-SX*SZ)/(SQRT(FX*FZ))
           IF(NOT.NE.1) GO TO 597
           R14 = 0.
           R24 = 0.
           R34 = 0.
      597  CONTINUE
           R23P4 = (R23-R24*R34)/(SQRT((1-R24**2)*(1-R34**2)))
  J        R12P4 = (R12-R14*R24)/(SQRT((1-R14**2)*(1-R34**2)))
           R13P4 = (R13-R14*R34)/(SQRT((1-R14**2)*(1-R24**2)))
           R12P34 = (R12P4-R13P4*R23P4)/(SQRT((1-R13P4**2)*(1-R23P4**2)))
           RHS = (1-R14**2)*(1-R13P4**2)*(1-R12P34**2)
           R1P234 = 1-RHS
           WRITE(6,599)R12,R13,R14
      599  FORMAT(///,28X,36HCORRELATION COEFFICIENT: KA WITH L =,F7.4,/,
```

(Continued)

Table D-4 (cont'd)

```
     +28X,36HCORRELATION COEFFICIENT: KA WITH G =,F7.4,/,
     +28X,36HCORRELATION COEFFICIENT: KA WITH T =,F7.4)
      WRITE(6,598)R1P234,NSUM
  598 FORMAT(27X,39HCOEFFICIENT OF MULTIPLE DETERMINATION =,F7.4,/,
     +41X,13HSAMPLE SIZE =,I5,///)
      AM(1,1)=NSUM
      AM(1,2)=SW
      AM(1,3)=SX
      AM(1,4)=SZ
      AM(2,1)=SW
      AM(2,2)=SWTWO
      AM(2,3)=SWX
      AM(2,4)=SWZ
      AM(3,1)=SX
      AM(3,2)=SWX
      AM(3,3)=SXTWO
      AM(3,4)=SXZ
K     AM(4,1)=SZ
      AM(4,2)=SWZ
      AM(4,3)=SXZ
      AM(4,4)=SZTWO
      BM(1)=SY
      BM(2)=SWY
      BM(3)=SXY
      BM(4)=SZY
      NEQ=4
      IF (NOT.EQ.1) NEQ=3
      CALL LINEQ1 (AM,BM,ANS,4,NEQ,1,NONO)
      IF (NONO.EQ.0) GO TO 350
      WRITE (6,530) NONO
      GO TO 370
  350 TEM=ANS(1)
      ANS(1)=EXP(TEM)
      COEFF = ANS(1)
L     A = ANS(2)
      B = ANS(3)
      C = ANS(4)
```

(Continued)

Table D-4 (cont'd)

```
L          IF(NOT.EQ.1) C = 0.
           SUM = 0.
           WRITE (6,480)
           WRITE (6,460)
           DO 360 I=1,NSUM,1
           XL=XLUSE(I)
M          G=GUSE(I)
           T=TEMUSE(I)
           COMPMA(I) = COEFF*(XL**A)*(G**B)*(T**C)
           RAT(I) = XMAUSE(I)/COMPMA(I)
       360 SUM = SUM + RAT(I)
           XBAR = SUM/NSUM
           SUM = 0.
           DO 361 I=1,NSUM
           DEV(I) = ABS(RAT(I)-XBAR)
N      361 SUM = SUM + DEV(I)**2
           STDDEV = SQRT(SUM/NSUM)
           DO 362 I=1,NSUM
       362 SIGMA(I) = DEV(I)/STDDEV
           DO 363 I=1,NSUM
           XL = XLUSE(I)
           G = GUSE(I)
           T = TEMUSE(I)
O          XMAP = COMPMA(I)
       363 WRITE(6,470)I,INO(I),NDATA(I),NDAY(I),XL,G,T,
          +XMAUSE(I),XMAP,RAT(I),ERR(I),SIGMA(I),DEV(I)
           WRITE(6,600) STDDEV,XBAR
           DELJ = RANGE/JSINB
           DO 364 J=1,JSINB
           BOT(J) = DELJ*(J-1)
P      364 TOP(J) = DELJ*J
           DO 369 J=1,JSINB
       369 NIN(J) = 0
           DO 367 I=1,NSUM
           TEST = RAT(I)
```

(Continued)

Table D-4 (cont'd)

```
        DO 366 J=1,JSINB
        JS = J
    366 IF(TEST.GE.BOT(J).AND.TEST.LT.TOP(J)) GO TO 371
P   371 NIN(JS) = NIN(JS)+1
    367 CONTINUE
        WRITE(6,620)
        DO 368 J=1,JSINB
    368 WRITE(6,630)J,BOT(J),TOP(J),NIN(J)
        WRITE(6,670)
    670 FORMAT(/////,39X,23HHISTOGRAM OF SIGMA DATA,//,39X,1HJ,4X,
       +3HBOT,5X,3HTOP,6X,1HN,/)
        DO 375 J=1,JSINB
    375 NIN(J) = 0
        DO 376 I=1,NSUM
        TEST = SIGMA(I)
        DO 377 J=1,JSINB
        JS = J
Q   377 IF(TEST.GE.BOT(J).AND.TEST.LT.TOP(J)) GO TO 378
        GO TO 379
    378 NIN(JS) = NIN(JS) + 1
    379 CONTINUE
    376 CONTINUE
        DO 381 J=1,JSINB
    381 WRITE(6,630)J,BOT(J),TOP(J),NIN(J)
    460 FORMAT(3X,1HI,3X,2HNO,4X,3HRUN,3X,3HDAY,4X,1HL,6X,1HG,5X,1HT,6X,
       +3HMAD,4X,3HMAC,4X,3HRAT,3X,3HERR,3X,5HSIGMA,3X,
       +3HDEV)
    470 FORMAT(1X,I4,1X,I4,1X,I6,2X,I3,2X,F6.0,1X,F5.0,1X,F6.5,1X,F6.4,1X,
       +F6.4,1X,F6.3,1X,F6.1,1X,F6.3,1X,F6.3)
    600 FORMAT(///,34X,9HSTDDEV = ,F6.3,4X,9HAVGRAT = ,F6.3)
    620 FORMAT(///,37X,28HHISTOGRAM OF MASS RATIO DATA,//,39X,1HJ,4X,
       +3HBOT,5X,3HTOP,6X,1HN,/)
    630 FORMAT(37X,I4,2X,F6.3,2X,F6.3,2X,I4)
        WRITE (6,490) ANS(1),ANS(2),ANS(3),C
    370 STOP
C
```

(Continued)

Table D-4 (cont'd)

```
 380 FORMAT(///,32X,37HCORRELATION OF TVA COOLING TOWER DATA,//,
    +41X,18HPERCENT WATER LOSS,///,
    +35X,29HPERCENT LOSS = KA*(W(1)-W(2)),///)
 480 FORMAT (//,40X,22HRESULTS OF CORRELATION,//)
 490 FORMAT (//,40X,22HCORRELATION PARAMETERS,//,44X,5HCO = ,E15.8,/,44
    1X,5HA  = ,F10.5,/,44X,5HB  = ,F10.5,/,44X,5HC  = ,F10.5)
 500 FORMAT (1H1)
 530 FORMAT(//,15X,7HNONO = ,I6,//)
 550 FORMAT (I3,I3,I3,F6.3,I2,F7.0)
 590 FORMAT (1X,I3,1X,I3)
C
     END
     FUNCTION WATSAP(T)
C    WHERE T IS THE TEMPERATURE IN DEG.F AND WATSAP THE
C    CORRESPONDING SATURATION PRESSURE (PSIA)
C    REFERENCE - ASHRAE HANDBOOK OF FUNDAMENTALS, 1977
     DIMENSION F(8)
     DATA F/-741.9242,-29.721,-11.55286,-.8685635,.1094098,
    1.439993,.2520658,.05218684/
     THETA=273.16/(((T-32.0)*5.0/9.0)+273.16)
     IF(THETA.GT.10.) THETA=10.0
     IF(THETA.LE.0.0) THETA=10.0
     IF(T.GE.32.0) GO TO 1
     XLOGPV=-9.096936*(THETA-1.0)-3.56654*ALOG10(THETA)
    C+.876817*(1.0-1.0/THETA)-2.2195983
     WATSAP=(10.0**XLOGPV)*14.696
     RETURN
   1 IF(T.GE.212.0) GO TO 2
     XLOGPV=10.79586*(1.0-THETA)+5.02808*ALOG10(THETA)
    C+1.50474E-4*(1.0-10.0**(-8.29692*(1.0/THETA-1.0)))
    C+.42873E-3*(10.0**(4.76955*(1.0-THETA))-1.0)-2.2195983
     WATSAP=14.696*(10.0**XLOGPV)
     RETURN
   2 IF(T.GT.705.0) WRITE(6,100)
     TC=273.16/THETA-273.16
```

(Continued)

Table D-4 (cont'd)

```
      SUM=F(1)
      DO 3 I=2,8
    3 SUM=SUM+F(I)*(.65-TC)**(I-1)
      XLOGE=.01*(374.136-TC)*SUM/THETA
      WATSAP=(217.99*EXP(XLOGE))*14.696
      RETURN
  100 FORMAT(1X*---FUNCTION WATSAP---*/*TEMPERATURE WAS*
     11X*OUT OF RANGE.  WATSAP WAS EXTRAPOLATED BEYOND*
     21X*705.0 DEG.F!  BE AWARE!*)
      END
      FUNCTION SATHUM(T,PT)
C     SATHUM CALCULATES THE SATURATED SPECIFIC HUMIDITY
C     (LBM WATER/LBM DRY AIR) GIVEN THE SATURATION TEMPERATURE
C     T(DEG.F) AND THE AMBIENT PRESSURE (PSIA)
      PVWSAT=WATSAP(T)
      SATHUM=.62198*PVWSAT/(PT-PVWSAT)
      RETURN
      END
#EOR
+++
```

TABLE D-5

SAMPLE OUTPUT FROM THE WATER LOSS CORRELATION CODE

```
                         CORRELATION OF TVA COOLING TOWER DATA

                                  PERCENT WATER LOSS

                          PERCENT LOSS = KA*(W(1)-W(2))


                        CORRELATION BASED ON LOG MEAN HUMIDITY
                         DIFFERENCE BETWEEN WATER AND AIR DEW
                                 POINT TEMPERATURES



                    CORRELATION COEFFICIENT: KA WITH L = -.6600
                    CORRELATION COEFFICIENT: KA WITH G =  .6462
                    CORRELATION COEFFICIENT: KA WITH T =  .7753
                  COEFFICIENT OF MULTIPLE DETERMINATION =  .9242
                               SAMPLE SIZE =  167



                                RESULTS OF CORRELATION

  I   NO    RUN   DAY     L      G       T       MAD     MAC     RAT   ERR  SIGMA   DEV
  1  173 121011   125  4011.   337.  .01185   .9493   .8370  1.134     0  1.143  .128
  2  174 121012   125  4012.   393.  .01085   .8756   .8544  1.025     0   .169  .019
  3  175 121013   125  4013.   380.  .01047   .8000   .8293   .965     0   .367  .041
  4  176 121014   125  4013.   427.  .01080   .7153   .8812   .812     0  1.731  .194
  5  177 121021   125  4008.   657.  .01433  1.1898  1.1902  1.000     0   .057  .006
  6  178 121022   125  4009.   666.  .01379  1.1778  1.1751  1.002     0   .033  .004
  7  179 121023   125  4010.   684.  .01328  1.1611  1.1672   .995     0   .100  .011
  8  180 121024   125  4009.   696.  .01376  1.1166  1.1950   .934     0   .638  .072
  9  181 121031   125  4009.  1226.  .01349  1.5093  1.4816  1.015     0   .083  .009
 10  182 121032   125  4010.  1308.  .01304  1.5121  1.4965  1.010     0   .040  .004
 11  183 121033   125  4010.  1324.  .01303  1.4931  1.5031   .993     0   .112  .013
 12  184 121034   125  4010.  1240.  .01253  1.4433  1.4384  1.003     0   .023  .003
 13  185 121041   128  5507.   267.  .00976   .6403   .5484  1.168     0  1.440  .162
 14  186 121061   128  5507.  1269.  .01027  1.0406  1.0394  1.001     0   .043  .005
 15  187 121062   128  5507.  1314.  .01044  1.0745  1.0619  1.012     0   .052  .006
 16  188 121063   128  5507.  1370.  .01044  1.0440  1.0793   .967     0   .345  .039
 17  189 121064   128  5508.  1343.  .01046  1.0214  1.0720   .953     0   .474  .053
 18  190 121071   128  6055.   333.  .00947   .6696   .5485  1.221     0  1.912  .215
 19  191 121072   128  6054.   349.  .00944   .5618   .5581  1.006     0   .004  .000
 20  192 121073   128  6054.   352.  .00936   .5567   .5580   .998     0   .074  .008
 21  193 121074   128  6053.   355.  .00961   .5139   .5663   .908     0   .877  .098
 22  194 121091   128  6722.  1400.  .01030   .9195   .9289   .990     0   .144  .016
 23  195 121092   128  6722.  1452.  .01052   .9161   .9512   .963     0   .382  .043
 24  196 121093   128  6722.  1454.  .01051   .9474   .9517   .995     0   .094  .011
 25  197 121094   128  6721.  1421.  .01052   .9883   .9435  1.048     0   .370  .042
 26  198 121101   129  8128.   393.  .01029   .4418   .4853   .910     0   .853  .096
```

(Continued)

Table D-5 (cont'd)

27	199	121102	129	8124.	405.	.01099	.4660	.5066	.520	0	.768	.086
28	200	121103	129	8123.	393.	.01053	.4605	.4909	.979	0	.243	.027
29	201	121104	129	8122.	407.	.01129	.5004	.5139	.974	0	.288	.032
30	202	121111	129	8104.	724.	.01116	.6517	.6427	1.014	0	.071	.008
31	203	121112	129	8107.	746.	.01199	.6221	.6697	.929	0	.686	.077
32	204	121113	129	8107.	733.	.01168	.7736	.6594	1.173	0	1.490	.167
33	205	121114	129	8103.	753.	.01167	.6558	.6664	.984	0	.195	.022
34	206	121121	129	8103.	1554.	.01187	.8830	.8949	.987	0	.171	.019
35	207	121122	129	8104.	1574.	.01202	.8443	.9046	.933	0	.648	.073
36	208	121123	129	8103.	1565.	.01196	.8499	.9003	.944	0	.552	.062
37	209	121124	129	8103.	1640.	.01229	.8734	.9286	.941	0	.584	.065
38	210	122011	129	4007.	358.	.01417	.8347	.9310	.897	0	.975	.109
39	211	122012	129	4006.	393.	.01409	.9007	.9638	.935	0	.637	.071
40	212	122013	129	4005.	384.	.01443	.9566	.9657	.991	0	.137	.015
41	213	122014	129	4004.	399.	.01623	.9971	1.0346	.964	0	.376	.042
42	214	122021	130	4012.	766.	.01540	1.2078	1.3062	.925	0	.725	.081
43	215	122022	130	4012.	765.	.01547	1.2623	1.3085	.965	0	.368	.041
44	216	122023	130	4010.	784.	.01563	1.3053	1.3275	.983	0	.202	.023
45	217	122024	130	4011.	724.	.01602	1.2614	1.3004	.970	0	.321	.036
46	218	122031	130	4003.	1541.	.01576	1.6209	1.7429	.930	0	.677	.076
47	219	122032	130	4004.	1563.	.01554	1.6394	1.7439	.940	0	.587	.066
48	220	122033	130	4004.	1590.	.01524	1.6176	1.7378	.931	0	.670	.075
49	221	122034	130	4004.	1519.	.01553	1.5382	1.7215	.894	0	1.002	.112
50	222	122041	132	5510.	278.	.00759	.4859	.4959	.980	0	.233	.026
51	223	122042	132	5509.	331.	.00912	.5339	.5484	.974	0	.289	.032
52	224	122043	132	5508.	335.	.00891	.5922	.5753	1.029	0	.209	.023
53	225	122043	132	5506.	354.	.00995	.5952	.6183	.963	0	.387	.043
54	226	122051	131	5481.	556.	.01005	.9459	.7453	1.269	0	2.345	.263
55	227	122052	131	5483.	527.	.00900	.8927	.6933	1.288	0	2.509	.282
56	228	122053	131	5485.	533.	.00829	.8757	.6705	1.306	0	2.674	.300
57	229	122054	131	5486.	552.	.00889	.8563	.7020	1.220	0	1.905	.214
58	230	122061	131	5482.	1185.	.01403	1.3786	1.1709	1.177	0	1.528	.171
59	231	122062	131	5481.	1159.	.01385	1.4721	1.1542	1.275	0	2.401	.269
60	232	122063	131	5481.	1226.	.01418	1.4195	1.1927	1.190	0	1.641	.184
61	233	122064	131	5481.	1211.	.01398	1.4319	1.1791	1.214	0	1.857	.208
62	234	122071	136	6756.	370.	.00740	.4353	.4699	.926	0	.708	.080
63	235	122072	136	6756.	349.	.00723	.4214	.4541	.928	0	.695	.078
64	236	122073	136	6757.	374.	.00718	.4169	.4655	.856	0	.984	.110
65	237	122074	136	6757.	359.	.00732	.4128	.4619	.894	0	1.000	.112
66	238	122081	136	6749.	664.	.00756	.6006	.5984	1.004	0	.020	.002
67	239	122082	136	6749.	698.	.00803	.6111	.6273	.974	0	.283	.032
68	240	122083	136	6749.	650.	.00814	.6231	.6137	1.015	0	.083	.009
69	241	122084	136	6749.	548.	.00743	.6373	.5504	1.190	0	1.354	.152
70	242	122091	136	6744.	1344.	.00798	.7872	.8112	.970	0	.316	.036
71	243	122092	136	6744.	1391.	.00753	.9988	.8009	1.247	0	2.148	.241
72	244	122093	136	6744.	1336.	.00795	.7706	.8099	.952	0	.485	.054
73	245	122094	136	6745.	1370.	.00749	.7671	.7941	.966	0	.356	.040
74	246	122101	136	8116.	348.	.00665	.3534	.3793	.932	0	.663	.074
75	247	122102	136	8115.	378.	.00679	.3542	.3961	.894	0	.997	.112
76	248	122121	136	8089.	1410.	.00879	.7141	.7517	.950	0	.499	.056
77	249	122122	136	8103.	1475.	.00954	.7376	.7931	.930	0	.677	.076
78	250	122123	136	8100.	1566.	.01097	.8063	.8625	.935	0	.634	.071
79	251	122124	136	8094.	1386.	.01159	.8948	.8461	1.058	0	.460	.052
80	252	123011	130	4019.	346.	.01342	.9044	.8941	1.012	0	.049	.006
81	253	123012	130	4018.	332.	.01369	.9513	.8878	1.072	0	.586	.066
82	254	123013	130	4017.	348.	.01423	.9261	.9208	1.006	0	.002	.000
83	255	123014	130	4017.	361.	.01369	.9129	.9177	.995	0	.100	.011
84	256	123021	130	4003.	791.	.01615	1.1892	1.3540	.878	0	1.138	.128
85	257	123022	130	4003.	767.	.01607	1.2963	1.3344	.971	0	.308	.035
86	258	123023	130	4004.	780.	.01572	1.2537	1.3297	.943	0	.562	.063
87	259	123024	130	4003.	848.	.01614	1.2491	1.3913	.898	0	.964	.108

(Continued)

Table D-5 (cont'd)

88	260	123031	130	4002.	1542.	.01557	1.6088	1.7344	.928	0	.699	.078
89	261	123032	130	4002.	1572.	.01554	1.6199	1.7462	.928	0	.698	.078
90	262	123033	130	4002.	1576.	.01526	1.5121	1.7336	.872	0	1.192	.134
91	263	123034	130	4002.	1598.	.01517	1.5628	1.7382	.899	0	.953	.107
92	264	123041	132	5505.	335.	.00940	.6255	.5898	1.061	0	.486	.055
93	265	123042	132	5505.	325.	.00939	.6121	.5826	1.051	0	.398	.045
94	266	123043	132	5505.	360.	.00970	.5652	.5854	.966	0	.360	.040
95	267	123044	132	5506.	342.	.00933	.6142	.5625	1.092	0	.766	.086
96	268	123051	131	5483.	502.	.01002	.6319	.7148	1.164	0	1.407	.159
97	269	123052	131	5481.	516.	.01023	.8535	.7292	1.170	0	1.465	.164
98	270	123053	131	5481.	517.	.01017	.8745	.7278	1.202	0	1.743	.196
99	271	123054	131	5481.	551.	.01049	.9212	.7574	1.216	0	1.874	.210
100	272	123061	131	5475.	1102.	.01128	1.2436	1.0308	1.206	0	1.786	.200
101	273	123062	131	5480.	1098.	.01168	1.2691	1.0416	1.218	0	1.893	.212
102	274	123063	131	5474.	1158.	.01129	1.2264	1.0513	1.176	0	1.516	.170
103	275	123064	131	5475.	1137.	.01126	1.2546	1.0425	1.203	0	1.759	.197
104	276	123071	137	6734.	398.	.01194	.6627	.6033	1.098	0	.823	.092
105	277	123072	137	6734.	415.	.01188	.7130	.6118	1.166	0	1.421	.160
106	278	123073	137	6734.	374.	.01202	.6766	.5906	1.146	0	1.245	.140
107	279	123074	137	6733.	344.	.01172	.6922	.5644	1.226	0	1.965	.220
108	280	123081	137	6715.	650.	.01264	.9559	.7534	1.269	0	2.341	.263
109	281	123082	137	6717.	700.	.01172	.9284	.7493	1.239	0	2.076	.233
110	282	123083	137	6718.	738.	.01297	.8937	.8014	1.115	0	.972	.109
111	283	123084	137	6718.	725.	.01177	.8849	.7611	1.163	0	1.395	.157
112	284	123092	137	6724.	1203.	.00953	1.0043	.8441	1.190	0	1.638	.184
113	285	123093	137	6725.	1397.	.00879	.8825	.8627	1.023	0	.151	.017
114	286	123094	137	6725.	1365.	.00920	.8829	.8730	1.011	0	.048	.005
115	287	123101	137	8079.	425.	.00808	.4565	.4505	1.013	0	.066	.007
116	288	123102	137	8078.	466.	.00833	.3854	.4737	.814	0	1.714	.192
117	289	123103	137	8078.	430.	.00828	.4053	.4578	.885	0	1.077	.121
118	290	123104	137	8078.	456.	.00882	.4156	.4768	.872	0	1.197	.134
119	291	123111	138	8090.	744.	.00957	.5527	.6073	.910	0	.854	.096
120	292	123112	138	8091.	766.	.00931	.5497	.6062	.907	0	.884	.099
121	293	123113	139	8091.	732.	.00948	.5811	.6003	.968	0	.338	.038
122	294	123114	138	8090.	930.	.01000	.5749	.6465	.889	0	1.040	.117
123	295	123121	136	8073.	1389.	.01192	.9719	.8601	1.130	0	1.105	.124
124	296	123122	136	8091.	1508.	.01238	.9136	.9024	1.012	0	.057	.006
125	297	123123	136	8072.	1393.	.01191	.9714	.8608	1.128	0	1.091	.122
126	298	123124	136	8089.	1484.	.01245	1.0191	.8993	1.133	0	1.134	.127
127	299	124011	130	4017.	364.	.01392	.9198	.9281	.991	0	.133	.015
128	300	124013	130	4017.	404.	.01428	.9292	.9783	.950	0	.500	.056
129	301	124014	130	4016.	419.	.01469	.9219	1.0044	.918	0	.785	.088
130	302	124021	130	4000.	812.	.01635	1.1852	1.3766	.861	0	1.292	.145
131	303	124022	130	4000.	752.	.01616	1.2784	1.3284	.962	0	.389	.044
132	304	124023	130	4000.	727.	.01618	1.2857	1.3117	.980	0	.230	.026
133	305	124024	130	4000.	759.	.01615	1.3130	1.3326	.985	0	.185	.021
134	306	124031	131	4007.	1430.	.01442	1.5670	1.6240	.965	0	.366	.041
135	307	124032	131	4007.	1441.	.01454	1.5779	1.6351	.965	0	.365	.041
136	308	124033	131	4007.	1404.	.01440	1.5764	1.6110	.978	0	.245	.027
137	309	124114	138	8050.	780.	.01152	.6522	.6754	.966	0	.159	.040
138	310	124121	139	8082.	1696.	.01123	.7773	.9050	.859	0	1.311	.147
139	311	124122	139	8059.	1902.	.01278	.8711	.9853	.884	0	1.087	.122
140	312	124123	139	8058.	1747.	.01327	.8920	.9904	.901	0	.939	.105
141	313	124124	139	8055.	1626.	.01327	.9555	.9628	.997	0	.084	.009
142	314	124034	131	4007.	1320.	.01906	1.6530	1.6049	.960	0	.341	.038
143	315	124042	132	5503.	275.	.00827	.5436	.5145	1.057	0	.452	.051
144	316	124043	132	5503.	314.	.00837	.5190	.5453	.952	0	.484	.054
145	317	124051	132	5492.	561.	.00861	.7506	.7316	1.026	0	.178	.020
146	318	124052	132	5492.	542.	.00954	.7432	.7190	1.034	0	.247	.028
147	319	124053	132	5490.	640.	.00988	.7424	.7809	.951	0	.492	.055
148	320	124054	132	5489.	672.	.01023	.7976	.8087	.986	0	.176	.020

(Continued)

Table D-5 (cont'd)

```
 149  321 124071  139   6763.   387. .00903  .3957  .5230   .757    0  2.222  .249
 150  322 124072  139   6763.   351. .00804  .4053  .4772   .849    0  1.396  .157
 151  323 124073  139   6763.   370. .00790  .4068  .4834   .842    0  1.464  .164
 152  324 124074  139   6766.   338. .00760  .4096  .4687   .874    0  1.178  .132
 153  325 124081  139   6755.   702. .00932  .6395  .6728   .951    0   .493  .055
 154  326 124082  139   6754.   632. .00935  .6615  .6662   .993    0   .116  .013
 155  327 124083  139   6754.   701. .00923  .6661  .6694   .995    0   .097  .011
 156  328 124084  139   6754.   639. .00917  .6553  .6628   .989    0   .155  .017
 157  329 124091  139   6746.  1434. .00961  .8375  .9069   .923    0   .735  .083
 158  330 124092  139   6745.  1474. .00990  .8637  .9284   .930    0   .674  .076
 159  331 124093  139   6745.  1472. .01018  .8763  .9397   .933    0   .654  .073
 160  332 124094  139   6744.  1450. .00987  .8759  .9210   .951    0   .490  .055
 161  333 124101  138   8073.   416. .01003  .4079  .4931   .827    0  1.593  .179
 162  334 124102  138   8070.   413. .01030  .3917  .4982   .786    0  1.958  .220
 163  335 124103  138   8070.   347. .01046  .4514  .4683   .964    0   .376  .042
 164  336 124104  138   8072.   340. .01020  .4422  .4591   .963    0   .382  .043
 165  337 124111  138   8050.   710. .01188  .6639  .6600  1.006    0   .001  .000
 166  338 124112  138   8049.   660. .01161  .6967  .6345  1.098    0   .819  .092
 167  339 124113  138   8050.   673. .01113  .7274  .6270  1.160    0  1.373  .154

                             STDDEV =   .112     AVGRAT =  1.006

                             HISTOGRAM OF MASS RATIO DATA
                                  J     BOT      TOP     N
                                  1       0     .100     0
                                  2    .100     .200     0
                                  3    .200     .300     0
                                  4    .300     .400     0
                                  5    .400     .500     0
                                  6    .500     .600     0
                                  7    .600     .700     0
                                  8    .700     .800     2
                                  9    .800     .900    21
                                 10    .900    1.000    80
                                 11   1.000    1.100    30
                                 12   1.100    1.200    18
                                 13   1.200    1.300    15
                                 14   1.300    1.400     1
                                 15   1.400    1.500     0
                                 16   1.500    1.600     0
                                 17   1.600    1.700     0
                                 18   1.700    1.800     0
                                 19   1.800    1.900     0
                                 20   1.900    2.000     0
                                 21   2.000    2.100     0
                                 22   2.100    2.200     0
                                 23   2.200    2.300     0
                                 24   2.300    2.400     0
                                 25   2.400    2.500     0
                                 26   2.500    2.600     0
                                 27   2.600    2.700     0
                                 28   2.700    2.800     0
                                 29   2.800    2.900     0
                                 30   2.900    3.000     0
```

(Continued)

Table D-5 (cont'd)

```
                 HISTOGRAM OF SIGMA DATA
                   BOT        TOP        N

            1       0        .100       22
            2     .100       .200       14
            3     .200       .300       10
            4     .300       .400       21
            5     .400       .500       10
            6     .500       .600        6
            7     .600       .700       19
            8     .700       .800        6
            9     .800       .900        6
           10     .900      1.000        7
           11    1.000      1.100        6
           12    1.100      1.200        7
           13    1.200      1.300        2
           14    1.300      1.400        5
           15    1.400      1.500        6
           16    1.500      1.600        3
           17    1.600      1.700        2
           18    1.700      1.800        5
           19    1.800      1.900        3
           20    1.900      2.000        4
           21    2.000      2.100        1
           22    2.100      2.200        1
           23    2.200      2.300        1
           24    2.300      2.400        2
           25    2.400      2.500        1
           26    2.500      2.600        1
           27    2.600      2.700        1
           28    2.700      2.800        0
           29    2.800      2.900        0
           30    2.900      3.000        0

             CORRELATION PARAMETERS

                 CO =   3.61829558E+02
                 A  =        -.76679
                 B  =         .39564
                 C  =         .45674
```

TABLE D-6

LISTING OF THE COLBURN j FACTOR CORRELATION COMPUTER CODE

```
      PROGRAM DRYCOR(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
      REAL J,J2
      DIMENSION RE(1000),XJ(1000),D(3),S(1000),T(1000)
      DIMENSION JDAT(1000),YJ(1000),ERR(1000)
      DIMENSION IDNO(1000)
      DIMENSION RAT(1000),DEV(1000),SIGMA(1000),BOT(50),TOP(50),
     +NIN(50)
      I=1
      WRITE(6,310)
      WRITE(6,311)
  310 FORMAT(1H1)
  311 FORMAT(///,32X,37HCORRELATION OF TVA COOLING TOWER DATA,//,34X,
     +32HCOLBURN J FACTOR VERSUS REYNOLDS,/,37X,24HNUMBER FOR DRY EXCHAN
     +GER,///,45X,11HJ = A*RE**B,///)
   10 READ(5,20)IA,IB,IC,ID,IE,IF,IDAT,XA,XB,XC,XD,XE,XF
   20 FORMAT(6I1,1X,I3,1X,6E11.4)
      IF(EOF,5) 13,19
   19 IF(IA .EQ. 2) GO TO 11
      IF(IA .EQ. 3) GO TO 12
      WRITE(6,23)
   23 FORMAT(10X,37HABORT CORRELATION. BAD CARD SEQUENCE.,//)
      GO TO 14
A  11 READ(5,21)
   21 FORMAT(/)
      READ(5,20)IA,IB,IC,ID,IE,IF,IDAT,XA,XB,XC,XD,XE,XF
      READ(5,22)
   22 FORMAT(//)
      RE(I)=XA
      XJ(I)=XD
      JDAT(I)=IDAT
```

(Continued)

Table D-6 (cont'd)

```
          IDNO(I)=100000*IA+10000*IB+1000*IC+100*ID+10*IE+IF
          I=I+1
          GO TO 10
       12 READ(5,22)
 A        RE(I)=XA
          XJ(I)=XD
          JDAT(I)=IDAT
          IDNO(I)=100000*IA+10000*IB+1000*IC+100*ID+10*IE+IF
          I=I+1
          GO TO 10
       13 N=I-1
          Z=0.
          Z2=0.
          ZJ=0.
          J=0.
          J2=0.
 B        DO 3 I=1,N
          S(I)=ALOG(RE(I))
          T(I)=ALOG(XJ(I))
          Z=Z+S(I)
          Z2=Z2+S(I)**2
          ZJ=ZJ+S(I)*T(I)
          J2 = J2+T(I)**2
        3 J=J+T(I)
          XN=FLOAT(N)
          D(1)=XN*Z2-Z*Z
 C        D(2)=J*Z2-Z*ZJ
          D(3)=XN*ZJ-J*Z
          TEMP=D(2)/D(1)
          A=EXP(TEMP)
          B=D(3)/D(1)
          FA = ZJ*N-Z*J
 D        FB = Z2*N - Z**2
          FC = J2*N - J**2
          CORCOJR = FA/(SQRT(FB*FC))
```

(Continued)

Table D-6 (cont'd)

```
D         WRITE(6,599)CORCOJR
      599 FORMAT(///,28X,36HCORRELATION COEFFICIENT: J WITH RE =,F7.4,///)
          WRITE(6,300)
      300 FORMAT(/,12X,3HRUN,2X,4HIDNO,2X,4HDATE,2X,8HREYN NUM,3X,6HJ DATA,
         +4X,6HJ CORR,4X,5HRATIO,3X,5HERROR,3X,5HSIGMA,4X,3HDEV,/)
          SUM = 0.
          DO 100 I=1,N
          YJ(I) = A*(RE(I)**B)
E         RAT(I) = XJ(I)/YJ(I)
      100 SUM = SUM + RAT(I)
          XBAR = SUM/N
          SUM = 0.
          DO 101 I=1,N
F         DEV(I) = ABS(RAT(I) - XBAR)
      101 SUM = SUM + DEV(I)**2
          STDDEV = SQRT(SUM/N)
          DO 102 I=1,N
G     102 SIGMA(I) = DEV(I)/STDDEV
          DO 103 I=1,N
      103 WRITE(6,301)I,IDNO(I),JDAT(I),RE(I),XJ(I),YJ(I),RAT(I),ERR(I),
H        +SIGMA(I),DEV(I)
      301 FORMAT(11X,I3,2X,I6,2X,I3,2X,F8.0,2X,F8.6,2X,F8.6,2X,F6.4,2X,F6.3,
         +2X,F6.3,2X,F6.3)
          WRITE(6,304) STDDEV,XBAR
      304 FORMAT(///,34X,9HSTDDEV = ,F6.3,4X,9HAVGRAT = ,F6.3,///)
          DELJ = 0.1
          DO 104 L=1,50
          BOT(L) = DELJ*(L-1)
      104 TOP(L) = DELJ*L
I         DO 105 L=1,50
      105 NIN(L) = 0
          DO 108 I=1,N
          TEST = RAT(I)
          DO 106 L=1,50
          LS = L
      106 IF(TEST.GE.BOT(L).AND.TEST.LT.TOP(L)) GO TO 107
```

(Continued)

Table D-6 (cont'd)

```
    107 NIN(LS) = NIN(LS) + 1
    108 CONTINUE
        WRITE(6,302)
I   302 FORMAT(/////,38X,26HHISTOGRAM OF J FACTOR DATA,//,39X,1HL,4X,
       +3HBOT,5X,3HTOP,6X,1HN,/)
        DO 109 L=1,50
    109 WRITE(6,303)L,BOT(L),TOP(L),NIN(L)
    303 FORMAT(37X,I4,2X,F6.3,2X,F6.3,2X,I4)
        DO 110 L=1,50
    110 NIN(L) = 0
        WRITE(6,305)
    305 FORMAT(/////,39X,23HHISTOGRAM OF SIGMA DATA,//,39X,1HL,4X,
       +3HBOT,5X,3HTOP,6X,1HN,/)
        DO 114 I=1,N
J       TEST = SIGMA(I)
        DO 111 L=1,50
        LS = L
    111 IF(TEST.GE.BOT(L).AND.TEST.LT.TOP(L)) GO TO 112
        GO TO 113
    112 NIN(LS) = NIN(LS) + 1
    113 CONTINUE
    114 CONTINUE
        DO 115 L=1,50
    115 WRITE(6,303) L,BOT(L),TOP(L),NIN(L)
        WRITE(6,200)A,B
    200 FORMAT(//////,5X,'THE CORRELATION IS:',5X,'J=',F6.4,' RE**',F6.4)
     14 STOP
        END
#EOR
+++
```

TABLE D-7

SAMPLE OUTPUT FROM THE COLBURN j FACTOR CORRELATION CODE

```
                    CORRELATION OF TVA COOLING TOWER DATA

                      COLBURN J FACTOR VERSUS REYNOLDS
                         NUMBER FOR DRY EXCHANGER

                               J = A*RE**B



               CORRELATION COEFFICIENT: J WITH RE = -.2622


     RUN  IDNO  DATE  REYN NUM   J DATA    J CORR   RATIO   ERROR   SIGMA   DEV

       1 322092  118    1679   .004174   .004662   .8953   .000    .491   .163
       2 322093  118    1487   .003926   .004780   .8214   .000    .714   .237
       3 322094  118     934   .004000   .005238   .7636   .000    .888   .295
       4 322101  118     905   .003273   .005294   .6181   .000   1.327   .440
       5 322102  118    1862   .004018   .004564   .8803   .000    .537   .178
       6 322103  118    2009   .003869   .004494   .8610   .000    .595   .197
       7 322104  118    1992   .003817   .004501   .8480   .000    .634   .210
       8 322111  119    1834   .004110   .004578   .8977   .000    .484   .161
       9 322112  119    1674   .004648   .004665   .9964   .000    .187   .062
      10 322113  119    1827   .004339   .004582   .9471   .000    .335   .111
      11 322114  119    1885   .004123   .004552   .9058   .000    .460   .153
      12 322131   93     765   .005212   .005480   .9510   .000    .324   .107
      13 322132   93     803   .006370   .005426  1.1740   .000    .348   .116
      14 322133   93     252   .005655   .006889   .8209   .000    .716   .238
      15 322134   93     651   .006626   .005597  1.1838   .000    .378   .125
      16 322141   93    1270   .003627   .004938   .7345   .000    .976   .324
      17 322142   93    1005   .003328   .005181   .6424   .000   1.253   .416
      18 322143   93    1090   .003239   .005096   .6356   .000   1.274   .423
      19 322144   93    1079   .003547   .005087   .6973   .000   1.088   .361
      20 322151   93    1740   .002773   .004628   .5993   .000   1.383   .459
      21 322152   93     892   .002907   .005310   .5473   .000   1.539   .511
      22 322153   93    1397   .003686   .004842   .7613   .000    .895   .297
      23 322154   93     948   .003557   .005244   .6784   .000   1.145   .380
      24 322161   93    1323   .003431   .004896   .7007   .000   1.078   .358
      25 322162   93    1482   .003942   .004783   .8242   .000    .706   .234
      26 322163   93    1345   .003512   .004880   .7195   .000   1.021   .339
      27 322164   93    2294   .002834   .004773   .5937   .000   1.379   .456
      28 322171   93    1530   .004274   .004752   .8993   .000    .480   .159
      29 322172   93    1663   .004098   .004672   .8771   .000    .546   .181
      30 322174   93    1833   .003775   .004579   .8244   .000    .705   .234
      31 322181   95    1440   .006133   .004812  1.2746   .000    .651   .216
      32 322182   95    1342   .005599   .004882  1.1468   .000    .266   .088
      33 322183   95    1343   .005866   .004881  1.2018   .000    .432   .143
      34 322184   95    1426   .006402   .004922  1.3279   .000    .812   .269
      35 323011  116     643   .005314   .005680   .9356   .000    .370   .123
      36 323012  116     373   .005322   .006354   .8376   .000    .665   .221
      37 323013  116     440   .005669   .006141   .9231   .000    .408   .135
```

(Continued)

Table D-7 (contd

38	323014	116	390	.005453	.006328	.8617	.000	.593	.197
39	323015	116	365	.004535	.006383	.7184	.000	1.025	.340
40	323021	116	979	.005386	.005209	1.0340	.000	.074	.024
41	323022	116	723	.005052	.005545	.9112	.000	.444	.197
42	323023	116	725	.005250	.005541	.9475	.000	.334	.111
43	323024	116	639	.005280	.005688	.9283	.000	.392	.130
44	323031	116	1353	.006636	.004874	1.3616	.000	.913	.303
45	323032	116	808	.005194	.005419	.9586	.000	.301	.100
46	323033	116	1172	.005536	.005020	1.1028	.000	.134	.044
47	323034	116	735	.004525	.005437	.8875	.000	.515	.171
48	323041	116	897	.005229	.005316	.9837	.000	.225	.075
49	323042	116	1009	.004587	.005177	.8860	.000	.520	.172
50	323043	116	993	.004615	.005205	.8867	.000	.518	.172
51	323044	116	931	.005319	.005264	.9726	.000	.259	.086
52	323051	117	1014	.003597	.005172	.6555	.000	1.093	.363
53	323052	117	1144	.002503	.005045	.4962	.000	1.694	.562
54	323053	117	1312	.003136	.004905	.6392	.000	1.263	.419
55	323054	117	1571	.002754	.004726	.5828	.000	1.433	.476
56	323061	117	1722	.003083	.004638	.6647	.000	1.186	.394
57	323062	117	1941	.004252	.004525	.9397	.000	.358	.119
58	323071	123	915	.006084	.005283	1.1516	.000	.281	.093
59	323072	123	835	.005598	.005382	1.0402	.000	.055	.018
60	323073	123	903	.005947	.005297	1.1227	.000	.194	.064
61	323074	123	872	.006310	.005334	1.1829	.000	.375	.124
62	323081	123	1286	.005411	.004925	1.0985	.000	.121	.040
63	323082	123	1241	.005267	.004961	1.0617	.000	.010	.003
64	323083	123	1236	.005907	.004968	1.1895	.000	.393	.131
65	323084	123	1145	.006098	.005044	1.2090	.000	.453	.151
66	323091	123	1245	.005517	.004958	1.1128	.000	.164	.054
67	323092	123	1256	.003987	.004949	.8055	.000	.762	.253
68	323093	123	1217	.004536	.004981	.9106	.000	.445	.148
69	323094	123	1376	.004241	.004857	.8733	.000	.558	.185
70	323101	123	1623	.004413	.004695	.9401	.000	.357	.118
71	323102	123	1470	.004267	.004792	.8906	.000	.506	.168
72	323103	123	1687	.004971	.004656	.9699	.000	.297	.099
73	323104	123	1742	.004547	.004627	.9828	.000	.228	.076
74	323111	125	1911	.004638	.004540	1.0216	.000	.111	.037
75	323112	125	1789	.004711	.004602	1.0239	.000	.104	.035
76	323113	125	1676	.004626	.004664	.9920	.000	.200	.066
77	323114	125	1698	.005722	.004652	1.2301	.000	.517	.172
78	323121	125	1880	.004780	.004555	1.0493	.000	.027	.009
79	323122	125	1837	.005139	.004576	1.1228	.000	.194	.064
80	323123	125	1942	.004935	.004574	1.0788	.000	.062	.020
81	323124	125	1770	.004716	.004612	1.0226	.000	.108	.036
82	323131	94	970	.003839	.005219	.7356	.000	.973	.323
83	323132	94	487	.005161	.006013	.8582	.000	.603	.200
84	323133	94	1031	.005562	.005154	1.0792	.000	.063	.021
85	323134	94	802	.004523	.005428	.8334	.000	.678	.225
86	323141	94	1333	.003967	.004889	.8114	.000	.744	.247
87	323142	94	997	.002641	.005190	.5088	.000	1.656	.550
88	323143	94	1181	.003610	.005012	.7201	.000	1.019	.338
89	323144	94	1574	.003491	.004722	.7393	.000	.962	.319
90	323151	95	1152	.006202	.005038	1.2311	.000	.520	.173
91	323152	95	1209	.006733	.004988	1.3499	.000	.878	.291
92	323153	95	1102	.007876	.005084	1.5493	.000	1.479	.491
93	323154	95	1217	.007381	.004981	1.4818	.000	1.276	.423
94	323161	95	1493	.006901	.004776	1.4450	.000	1.164	.387
95	323162	95	1432	.006675	.004817	1.3857	.000	.986	.327
96	323163	95	1363	.006528	.004867	1.3414	.000	.852	.283
97	323164	95	1479	.006662	.004786	1.3922	.000	1.005	.334
98	323171	95	1479	.006514	.004785	1.3613	.000	.913	.303

(Continued)

Table D-7 (cont'd)

99	323172	95	1501	.006588	.004771	1.3810	.000	.972	.323
100	323173	95	1421	.006412	.004825	1.3290	.000	.815	.271
101	323174	95	1522	.006524	.004757	1.3714	.000	.943	.313
102	323181	95	1578	.006710	.004722	1.4209	.000	1.092	.362
103	323182	95	1512	.006035	.004764	1.2794	.000	.666	.221
104	323183	95	1371	.006121	.004860	1.2593	.000	.605	.201
105	323184	95	1480	.006152	.004785	1.2858	.000	.685	.227
106	321021	37	1234	.007477	.004919	1.5203	.000	1.391	.462
107	321022	37	1407	.008048	.004834	1.6648	.000	1.827	.606
108	321023	37	1394	.008322	.004844	1.7180	.000	1.987	.660
109	321024	37	1355	.007631	.004872	1.6072	.000	1.653	.549
110	321025	37	1345	.007942	.004880	1.6275	.000	1.714	.569
111	321031	37	868	.005916	.005340	1.1078	.000	.149	.049
112	321032	37	774	.005409	.005467	.9894	.000	.208	.069
113	320133	37	1497	.007525	.004774	1.5763	.000	1.560	.518
114	321034	37	1414	.007794	.004830	1.6136	.000	1.673	.555
115	321035	37	1481	.008042	.004784	1.6812	.000	1.876	.623
116	321041	37	934	.005139	.005260	.9770	.000	.245	.081
117	321051	37	1969	.006839	.004512	1.5159	.000	1.378	.457
118	321052	37	1863	.007198	.004564	1.5773	.000	1.563	.519
119	321053	37	1897	.008196	.004551	1.8007	.000	2.236	.742
120	321054	37	1897	.006812	.004547	1.4982	.000	1.325	.440
121	321061	37	2051	.007249	.004474	1.6201	.000	1.692	.562
122	321062	37	2062	.006881	.004469	1.5396	.000	1.450	.481
123	321063	37	2220	.007412	.004402	1.6839	.000	1.884	.625
124	321064	37	2176	.007386	.004420	1.6710	.000	1.845	.613
125	321081	38	1429	.007711	.004822	1.5992	.000	1.629	.541
126	321082	38	1110	.006812	.005076	1.3419	.000	.854	.283
127	321083	38	1281	.007329	.004929	1.4870	.000	1.291	.429
128	321084	38	1253	.007315	.004951	1.4774	.000	1.262	.419
129	321091	38	1349	.007871	.004740	1.6604	.000	1.814	.602
130	321092	38	1470	.007554	.004792	1.5765	.000	1.561	.518
131	321093	38	1380	.007416	.004854	1.5276	.000	1.414	.469
132	321094	38	1473	.007331	.004785	1.5319	.000	1.426	.473
133	321101	39	1300	.005909	.004919	1.2024	.000	.434	.144
134	321102	39	1195	.005825	.005000	1.1650	.000	.321	.107
135	321103	39	1416	.006499	.004828	1.3460	.000	.866	.288
136	321104	39	1267	.006610	.004940	1.3381	.000	.843	.280
137	321111	39	1466	.006525	.004794	1.3617	.000	.914	.303
138	321112	39	1504	.006543	.004769	1.3720	.000	.945	.314
139	321113	39	1546	.006651	.004742	1.4025	.000	1.037	.344
140	321114	39	1277	.006038	.004932	1.2242	.000	.499	.166
141	321131	43	867	.005957	.005341	1.1153	.000	.171	.057
142	321132	43	954	.006184	.005237	1.1807	.000	.368	.122
143	321133	43	751	.005731	.005501	1.0418	.000	.050	.017
144	321134	43	893	.005691	.005309	1.0719	.000	.040	.013
145	321141	43	911	.004885	.005288	.9239	.000	.405	.135
146	321142	43	1504	.003638	.004769	.7628	.000	.891	.296
147	321151	44	1201	.005862	.004995	1.1736	.000	.347	.115
148	321152	44	1314	.006476	.004903	1.3209	.000	.791	.262
149	321153	44	1276	.006634	.004933	1.3459	.000	.863	.286
150	321154	44	364	.005822	.005345	1.0891	.000	.092	.031
151	322011	76	702	.005518	.005578	.9893	.000	.208	.069
152	322012	76	707	.005118	.005571	.9188	.000	.421	.140
153	322013	76	762	.005927	.005485	1.0806	.000	.067	.022
154	322014	76	289	.004399	.006696	.6570	.000	1.210	.401
155	322015	76	601	.006336	.005760	1.1000	.000	.125	.042
156	322031	95	799	.005815	.005432	1.0705	.000	.036	.012
157	322032	95	1276	.006769	.004933	1.3721	.000	.945	.314
158	322033	95	1523	.007129	.004756	1.4988	.000	1.327	.440
159	322034	95	1704	.005900	.004648	1.2694	.000	.635	.211

(Continued)

Table D-7 (cont'd)

```
 160   322041    95      2624   .005912   .004253   1.3901    .000     .999    .332
 161   322051   114      5503   .000820   .003652    .2246    .000    2.512    .834
 162   322052   114      3010   .001761   .004135    .4235    .000    1.913    .635
 163   322053   114      2946   .002184   .004153    .5260    .000    1.604    .532
 164   322054   114      2989   .002082   .004141    .5028    .000    1.674    .556
 165   322061   114      7054   .000832   .003470    .2397    .000    2.467    .819
 166   322064   114      3683   .001396   .003966    .3520    .000    2.128    .706
 167   322071   118       363   .003688   .006389    .5773    .000    1.450    .481
 168   322072   118       896   .004203   .005305    .7922    .000     .802    .266
 169   322073   118       387   .003456   .006307    .5480    .000    1.538    .510
 170   322074   118       864   .004226   .005227    .8085    .600     .753    .250
 171   322081   118       526   .003534   .005919    .5970    .000    1.390    .461
 172   322082   118      1691   .004209   .004656    .9042    .000     .465    .154
 173   322083   118       596   .003712   .005789    .6412    .000    1.257    .417
 174   322084   118      1507   .004242   .004767    .8895    .000     .508    .169
 175   322085   118       849   .003675   .005364    .6851    .000    1.125    .373
 176   322091   118      1506   .004587   .004767    .9622    .000     .290    .096

                         STDDEV =   .332     AVGRAT =   1.058



                             HISTOGRAM OF J FACTOR DATA
                             L       BOT       TOP        N

                             1       .000      .100       0
                             2       .100      .200       0
                             3       .200      .300       2
                             4       .300      .400       1
                             5       .400      .500       2
                             6       .500      .600       9
                             7       .600      .700      12
                             8       .700      .800      11
                             9       .800      .900      24
                            10       .900     1.000      25
                            11      1.000     1.100      15
                            12      1.100     1.200      16
                            13      1.200     1.300      11
                            14      1.300     1.400      19
                            15      1.400     1.500       8
                            16      1.500     1.600      10
                            17      1.600     1.700       9
                            18      1.700     1.800       1
                            19      1.800     1.900       1
                            20      1.900     2.000       0
                            21      2.000     2.100       0
                            22      2.100     2.200       0
                            23      2.200     2.300       0
                            24      2.300     2.400       0
                            25      2.400     2.500       0
                            26      2.500     2.600       0
                            27      2.600     2.700       0
                            28      2.700     2.800       0
```

(Continued)

Table D-7 (cont'd)

```
 29    2.800     2.900      0
 30    2.900     3.000      0
 31    3.000     3.100      0
 32    3.100     3.200      0
 33    3.200     3.300      0
 34    3.300     3.400      0
 35    3.400     3.500      0
 36    3.500     3.600      0
 37    3.600     3.700      0
 38    3.700     3.800      0
 39    3.800     3.900      0
 40    3.900     4.000      0
 41    4.000     4.100      0
 42    4.100     4.200      0
 43    4.200     4.300      0
 44    4.300     4.400      0
 45    4.400     4.500      0
 46    4.500     4.600      0
 47    4.600     4.700      0
 48    4.700     4.800      0
 49    4.800     4.900      0
 50    4.900     5.000      0


HISTOGRAM OF SIGMA DATA
L      BOT       TOP        N
  1     .000      .100     11
  2     .100      .200     12
  3     .200      .300     11
  4     .300      .400     15
  5     .400      .500     14
  6     .500      .600     12
  7     .600      .700      9
  8     .700      .800      8
  9     .800      .900     12
 10     .900     1.000     12
 11    1.000     1.100      9
 12    1.100     1.200      9
 13    1.200     1.300      8
 14    1.300     1.400      9
 15    1.400     1.500      6
 16    1.500     1.600      5
 17    1.600     1.700      8
 18    1.700     1.800      1
 19    1.800     1.900      5
 20    1.900     2.000      2
 21    2.000     2.100      0
 22    2.100     2.200      1
 23    2.200     2.300      1
 24    2.300     2.400      0
 25    2.400     2.500      1
 26    2.500     2.600      1
 27    2.600     2.700      0
 28    2.700     2.800      0
 29    2.800     2.900      0
 30    2.900     3.000      0
```

(Continued)

Table D-7 (cont'd)

31	3.000	3.100	0
32	3.100	3.200	0
33	3.200	3.300	0
34	3.300	3.400	0
35	3.400	3.500	0
36	3.500	3.600	0
37	3.600	3.700	0
38	3.700	3.800	0
39	3.800	3.900	0
40	3.900	4.000	0
41	4.000	4.100	0
42	4.100	4.200	0
43	4.200	4.300	0
44	4.300	4.400	0
45	4.400	4.500	0
46	4.500	4.600	0
47	4.600	4.700	0
48	4.700	4.800	0
49	4.800	4.900	0
50	4.900	5.000	0

TABLE D-8

LISTING OF THE FAN SYSTEM EFFICIENCY CORRELATION COMPUTER CODE

```
              PROGRAM FANCOR(TOWFAN,OUTPUT,TAPE5=TOWFAN,TAPE6=OUTPUT)
      PROGRAM FANCOR (TOWFAN,OUTPUT,TAPE5=TOWFAN,TAPE6=OUTPUT)
      DIMENSION Q(600), ETA(600), COEF(10), ETASTAR(600), DEV(600), RATI
     1O(600), IDATE(600), ICODE(6)
      I=1
      ITPRINT=1
      NORDER=1
  109 READ (5,189) IGARB
      IF (EOF(5)) 129,119
  119 READ (5,189)
      READ (5,189)
A     READ (5,199) ICODE,IDATE(I),RPM,FANANG,HP,SSP,Q1,DPFQ,Q(I),ETAMEAS
     1,ETA(I),ETAFQ
      NUMPTS=I
      I=I+1
      GO TO 109
  129 CONTINUE
      CALL LSTSQ (NUMPTS,NORDER,Q,ETA,COEF)
B     NSTOP=NORDER+1
      WRITE (6,209) (COEF(J),J=1,NSTOP)
      XIYI=0.0
      YI=0.0
C     XI=YI
      XI2=0.0
      YI2=0.0
      DO 139 I=1,NUMPTS
         XIYI=XIYI+Q(I)*ETA(I)
         XI=XI+Q(I)
```

(Continued)

Table D-8 (cont'd)

```
C          YI=YI+ETA(I)
           XI2=XI2+Q(I)**2
     139 YI2=YI2+ETA(I)**2
         RXY=(NUMPTS*XIYI-XI*YI)/(SQRT(NUMPTS*XI2-XI**2)*SQRT(NUMPTS*YI2-YI
        1**2))
         WRITE (6,219) RXY
         YBAR=0.0
         DO 149 I=1,NUMPTS
            ETASTAR(I)=COEF(1)+Q(I)*COEF(2)
            RATIO(I)=ETA(I)/ETASTAR(I)
D    149 YBAR=YBAR+RATIO(I)
         YBAR=YBAR/NUMPTS
         WRITE (6,249) YBAR
         DEVSUM=0.0
         DO 159 I=1,NUMPTS
E           DEV(I)=ABS(RATIO(I)-YBAR)
     159 DEVSUM=DEVSUM+DEV(I)**2
         SIGMA=SQRT(DEVSUM/FLOAT(NUMPTS))
         IF (ITPRINT.NE.1) GO TO 179
         DO 169 I=1,NUMPTS
F    169 WRITE (6,229) IDATE(I),Q(I),RATIO(I),DEV(I)
     179 WRITE (6,239) SIGMA
         STOP
    C
     189 FORMAT (1X,I6)
     199 FORMAT (6I1,1X,I3,1X,6E11.4/7E11.4)
     209 FORMAT (1X, 26HLEAST SQUARES COEFFICIENTS,/1X,10E10.3)
     219 FORMAT (1X, 23HCORRELATION COEFFICIENT,/1X,10E10.3///)
'76        *C L E A N*                                                01/08/80
              PROGRAM FANCOR(TOWFAN,OUTPUT,TAPE5=TOWFAN,TAPE6=OUTPUT)
     229 FORMAT (1X,I3,3X,E10.3,3X,E10.3,3X,E10.3)
     239 FORMAT (1X, 19HSTANDARD DEVIATION=,E10.3)
     249 FORMAT (1X,  5HYBAR=,2X,E10.3)
    C
         END
```

TABLE D-9

SAMPLE OUTPUT FROM THE FAN SYSTEM EFFICIENCY CORRELATION CODE

Date Q η_i/η_i^* Dev.

```
LEAST SQUARES COEFFICIENTS
-1.004E-02 2.400E-07
CORRELATION COEFFICIENT
 8.872E-01
YBAR=     9.920E-01
139      2.336E+05      8.222E-01      1.698E-01
139      2.666E+05      9.591E-01      3.283E-02
139      2.375E+05      9.396E-01      5.238E-02
139      2.745E+05      8.370E-01      1.549E-01
142      5.335E+05      9.671E-01      2.482E-02
142      5.057E+05      9.476E-01      4.442E-02
142      4.891E+05      8.747E-01      1.173E-01
142      4.876E+05      9.905E-01      1.496E-03
142      6.924E+05      8.849E-01      1.070E-01
142      6.756E+05      8.932E-01      9.878E-02
142      7.709E+05      8.769E-01      1.151E-01
142      6.932E+05      9.336E-01      5.835E-02
310      8.743E+05      9.365E-01      5.546E-02
310      8.296E+05      1.013E+00      2.151E-02
310      1.028E+06      9.718E-01      2.020E-02
310      9.553E+05      1.054E+00      6.204E-02
310      9.527E+05      9.843E-01      7.639E-03
142      1.008E+06      8.381E-01      1.539E-01
142      8.985E+05      8.709E-01      1.211E-01
142      1.000E+06      9.170E-01      7.498E-02
142      9.713E+05      8.984E-01      9.358E-02
142      1.089E+06      9.384E-01      5.359E-02
142      1.040E+06      9.159E-01      7.604E-02
142      1.025E+06      9.363E-01      5.565E-02
142      1.065E+06      9.159E-01      7.610E-02
142      1.092E+06      9.638E-01      2.815E-02
142      2.472E+05      8.922E-01      9.979E-02
142      2.433E+05      7.531E-01      2.389E-01
142      2.181E+05      7.117E-01      2.803E-01
142      2.112E+05      9.666E-01      2.535E-02
311      6.624E+05      1.040E+00      4.815E-02
311      6.461E+05      1.047E+00      5.517E-02
311      6.554E+05      1.050E+00      5.776E-02
311      6.867E+05      1.034E+00      4.213E-02
311      6.880E+05      1.040E+00      4.842E-02
145      5.937E+05      1.065E+00      7.302E-02
145      5.674E+05      1.059E+00      7.706E-02
145      5.949E+05      1.037E+00      4.509E-02
145      6.034E+05      1.051E+00      5.911E-02
311      9.703E+05      1.024E+00      3.239E-02
311      9.898E+05      1.021E+00      2.952E-02
311      1.020E+06      1.015E+00      2.285E-02
311      1.025E+06      1.022E+00      3.026E-02
311      9.826E+05      1.026E+00      3.399E-02
146      8.055E+05      9.792E-01      1.280E-02
```

(Continued)

Table D-9 (cont'd)

146	8.202E+05	9.605E-01	3.145E-02
146	8.134E+05	9.687E-01	2.328E-02
146	8.181E+05	9.609E-01	3.106E-02
146	8.898E+05	9.930E-01	1.068E-03
146	9.299E+05	9.986E-01	6.631E-03
146	9.671E+05	9.954E-01	3.465E-03
146	9.357E+05	9.997E-01	7.747E-03
146	3.138E+05	9.084E-01	8.353E-02
146	2.918E+05	9.628E-01	2.914E-02
146	2.942E+05	9.393E-01	5.264E-02
146	2.872E+05	9.620E-01	2.992E-02
146	5.276E+05	1.037E+00	4.490E-02
146	5.376E+05	1.067E+00	7.484E-02
146	5.106E+05	1.095E+00	1.033E-01
146	5.189E+05	1.070E+00	7.777E-02
146	5.137E+05	1.082E+00	9.053E-02
311	9.711E+05	1.093E+00	1.007E-01
311	9.630E+05	1.075E+00	8.254E-02
311	9.641E+05	1.070E+00	7.760E-02
311	9.235E+05	1.081E+00	8.951E-02
311	9.177E+05	1.061E+00	6.922E-02
146	7.631E+05	1.018E+00	2.652E-02
146	8.221E+05	1.025E+00	3.262E-02
146	7.826E+05	1.033E+00	4.082E-02
146	7.547E+05	1.020E+00	2.817E-02
150	9.883E+05	1.060E+00	6.801E-02
150	9.818E+05	1.035E+00	4.262E-02
150	9.523E+05	1.042E+00	4.995E-02
150	9.607E+05	1.027E+00	3.472E-02
150	1.067E+06	1.006E+00	1.356E-02
150	1.060E+06	9.937E-01	1.747E-03
150	1.085E+06	1.011E+00	1.866E-02
150	1.101E+06	1.010E+00	1.791E-02
150	3.344E+05	1.007E+00	1.466E-02
150	3.314E+05	9.994E-01	7.390E-03
150	3.416E+05	1.010E+00	1.754E-02
150	3.386E+05	1.013E+00	2.144E-02
150	6.143E+05	1.096E+00	1.036E-01
150	5.977E+05	1.039E+00	4.656E-02
150	6.228E+05	1.646E+00	6.540E-01
150	6.146E+05	1.068E+00	7.617E-02
150	7.361E+05	1.023E+00	3.072E-02
150	7.309E+05	1.024E+00	3.180E-02
150	7.177E+05	1.036E+00	4.364E-02
150	7.513E+05	1.004E+00	1.205E-02
150	6.719E+05	1.053E+00	6.128E-02
150	8.952E+05	1.029E+00	3.700E-02
150	8.819E+05	1.049E+00	5.741E-02
150	9.219E+05	1.050E+00	5.815E-02
151	1.078E+06	1.067E+00	7.551E-02
151	1.058E+06	1.068E+00	7.596E-02
151	1.059E+06	1.051E+00	5.863E-02
151	1.106E+06	1.042E+00	5.027E-02
151	2.178E+06	1.016E+00	2.359E-02
151	2.156E+06	1.003E+00	1.062E-02
151	2.112E+06	9.844E-01	7.551E-03
151	2.154E+06	1.007E+00	1.519E-02
151	3.426E+05	9.060E-01	8.595E-02
151	3.219E+05	8.691E-01	1.228E-01
151	3.441E+05	8.871E-01	1.049E-01
151	3.621E+05	8.980E-01	9.400E-02

(Continued)

Table D-9 (cont'd)

151	3.413E+05	9.617E-01	3.029E-02
151	6.477E+05	1.063E+00	7.063E-02
151	5.982E+05	1.013E+00	2.114E-02
151	6.364E+05	1.061E+00	6.912E-02
151	5.992E+05	1.104E+00	1.116E-01
151	6.533E+05	1.071E+00	7.918E-02
164	1.160E+06	9.275E-01	6.451E-02
164	1.104E+06	9.551E-01	3.686E-02
164	1.130E+06	9.562E-01	3.580E-02
164	1.185E+06	1.021E+00	2.885E-02
164	1.166E+06	9.945E-01	2.519E-03
152	2.407E+05	8.758E-01	1.162E-01
152	2.458E+05	8.772E-01	1.148E-01
152	2.428E+05	9.369E-01	5.503E-02
152	2.661E+05	8.833E-01	1.086E-01
152	2.612E+05	8.654E-01	1.266E-01
152	4.924E+05	1.025E+00	3.285E-02
152	5.085E+05	1.003E+00	1.116E-02
152	5.071E+05	9.928E-01	8.362E-04
152	5.106E+05	1.032E+00	3.991E-02
152	4.609E+05	1.049E+00	5.744E-02
152	5.820E+05	9.351E-01	5.687E-02
152	6.083E+05	9.790E-01	1.298E-02
152	6.258E+05	1.009E+00	1.726E-02
152	6.252E+05	9.721E-01	1.991E-02
152	6.117E+05	9.794E-01	1.257E-02
164	1.123E+06	9.431E-01	4.884E-02
164	1.161E+06	9.732E-01	1.874E-02
164	1.114E+06	9.512E-01	4.072E-02
164	1.122E+06	9.717E-01	2.028E-02
164	1.059E+06	9.980E-01	6.044E-03
165	2.738E+05	5.112E-01	4.808E-01
165	2.806E+05	6.857E-01	3.063E-01
165	2.449E+05	7.531E-01	2.389E-01
165	2.794E+05	6.216E-01	3.704E-01
165	2.313E+05	5.726E-01	4.193E-01
164	6.113E+05	9.468E-01	4.521E-02
164	6.184E+05	8.429E-01	1.491E-01
164	6.130E+05	9.050E-01	8.696E-02
164	6.145E+05	8.342E-01	1.577E-01
164	6.282E+05	8.740E-01	1.180E-01
164	6.506E+05	9.876E-01	4.363E-03
164	7.604E+05	9.535E+01	3.846E-02
164	7.522E+05	9.866E-01	5.353E-03
164	7.863E+05	9.830E-01	8.989E-03
164	7.772E+05	9.730E-01	1.899E-02
164	9.467E+05	1.011E+00	1.953E-02
164	9.482E+05	9.818E-01	1.018E-02
164	9.813E+05	2.689E-01	7.230E-01
164	3.814E+05	9.420E-01	4.998E-02
164	9.457E+05	9.858E-01	6.136E-03
164	1.105E+06	9.545E-01	3.746E-02
164	1.078E+06	9.139E-01	7.803E-02
164	1.157E+06	9.243E-01	6.764E-02
164	1.064E+06	9.445E-01	4.742E-02
164	1.071E+06	1.006E+00	1.445E-02
165	1.274E+06	9.347E-01	5.727E-02
165	1.113E+06	9.642E-01	2.775E-02
165	1.317E+06	9.069E-01	8.503E-02
165	1.275E+06	9.366E-01	5.542E-02
165	1.240E+06	9.282E-01	6.376E-02

(Continued)

Table D-9 (cont'd)

165	2.685E+05	7.219E-01	2.701E-01
165	2.163E+05	8.708E-01	1.212E-01
165	2.535E+05	7.388E-01	2.531E-01
165	2.435E+05	1.026E+00	3.408E-02
165	2.456E+05	9.317E-01	6.028E-02
165	5.349E+05	8.838E-01	1.082E-01
165	5.197E+05	9.605E-01	3.151E-02
165	5.106E+05	8.819E-01	1.101E-01
165	5.487E+05	8.938E-01	9.816E-02
165	5.708E+05	8.361E-01	1.558E-01
165	7.745E+05	9.319E-01	6.011E-02
165	7.280E+05	9.190E-01	7.293E-02
165	7.824E+05	9.143E-01	7.768E-02
165	7.052E+05	9.269E-01	6.511E-02
165	8.248E+05	9.305E-01	6.142E-02
165	9.469E+05	9.660E-01	2.600E-02
165	9.558E+05	1.004E+00	1.187E-02
165	9.443E+05	9.406E-01	5.135E-02
165	1.061E+06	9.196E-01	7.234E-02
165	1.009E+06	9.606E-01	3.134E-02
165	1.255E+06	9.632E-01	2.882E-02
165	1.152E+06	9.148E-01	7.715E-02
165	1.216E+06	8.874E-01	1.046E-01
165	1.145E+06	9.478E-01	4.414E-02
165	1.315E+06	9.563E-01	3.572E-02
165	1.286E+06	9.871E-01	4.854E-03
165	1.255E+06	9.566E-01	3.536E-02
165	1.377E+06	9.359E-01	5.606E-02
165	1.383E+06	9.808E-01	1.117E-02
166	3.040E+05	9.507E-01	4.130E-02
166	2.716E+05	9.403E-01	5.165E-02
166	3.056E+05	9.752E-01	1.679E-02
166	2.866E+05	9.951E-01	3.104E-03
166	3.086E+05	1.009E+00	1.710E-02
166	5.167E+05	9.886E-01	3.419E-03
166	5.440E+05	1.667E+00	6.754E-01
166	5.493E+05	9.806E-01	1.138E-02
166	5.767E+05	9.881E-01	3.846E-03
166	6.090E+05	9.743E-01	1.764E-02
166	7.197E+05	1.051E+00	5.856E-02
166	7.244E+05	0	9.920E-01
166	7.305E+05	9.687E-01	2.326E-02
166	7.102E+05	5.384E+00	4.392E+00
166	7.309E+05	1.032E+00	4.020E-02
166	9.219E+05	3.584E-01	6.336E-01
166	9.151E+05	3.507E-01	6.412E-01
166	8.569E+05	1.224E+00	2.323E-01
166	8.458E+05	1.250E+00	2.579E-01
166	8.924E+05	1.255E+00	2.630E-01
166	9.841E+05	1.039E+00	4.677E-02
166	9.186E+05	1.050E+00	5.814E-02
166	1.031E+06	1.077E+00	8.537E-02
166	9.576E+05	1.053E+00	6.094E-02
166	9.320E+05	1.074E+00	8.158E-02
166	1.123E+06	1.069E+00	7.717E-02
166	1.088E+06	1.065E+00	7.270E-02
166	1.066E+06	1.017E+00	2.501E-02
166	1.143E+06	1.012E+00	2.003E-02
166	1.097E+06	1.041E+00	4.933E-02
167	2.353E+05	1.088E+00	1.578E-02
167	2.217E+05	1.081E+00	8.854E-02

(Continued)

Table D-9 (cont'd)

167	2.355E+05	1.029E+00	3.686E-02
167	2.196E+05	1.041E+00	4.861E-02
167	2.536E+05	1.042E+00	4.963E-02
167	4.733E+05	1.716E+00	7.245E-01
167	4.872E+05	4.098E-04	9.916E-01
167	4.873E+05	1.040E+00	4.777E-02
167	5.159E+05	1.062E+00	6.968E-02
167	4.701E+05	9.887E-01	3.271E-03
167	5.356E+05	1.044E+00	5.213E-02
167	5.946E+05	1.032E+00	4.006E-02
167	6.315E+05	1.052E+00	6.026E-02
167	6.144E+05	1.029E+00	3.661E-02
167	7.120E+05	1.075E+00	8.273E-02
167	7.096E+05	1.102E+00	1.099E-01
167	8.139E+05	1.055E+00	6.312E-02
167	7.483E+05	1.086E+00	9.390E-02
167	7.043E+05	1.048E+00	5.609E-02
167	9.090E+05	9.679E-01	2.406E-02
167	9.202E+05	9.835E-01	8.465E-03
167	8.083E+05	9.620E-01	2.994E-02
167	8.430E+05	9.556E-01	3.635E-02
167	8.422E+05	9.690E-01	2.299E-02
167	8.793E+05	9.811E-01	1.087E-02
167	9.030E+05	0	9.920E-01
167	8.498E+05	1.007E+00	1.515E-02
167	8.617E+05	9.968E-01	4.811E-03
167	8.505E+05	1.002E+00	9.958E-03
167	5.185E+05	9.092E-01	8.275E-02
167	5.452E+05	9.548E-01	3.716E-02
167	4.835E+05	9.536E-01	3.841E-02
167	5.144E+05	1.106E+00	1.140E-01
167	5.122E+05	1.064E+00	7.247E-02
170	1.174E+06	1.019E+00	2.656E-02
170	1.125E+06	1.003E+00	1.068E-02
170	1.129E+06	1.011E+00	1.930E-02
170	1.146E+06	1.020E+00	2.810E-02
170	1.157E+06	1.027E+00	3.491E-02
170	7.549E+05	1.110E+00	1.177E-01
170	7.794E+05	1.060E+00	6.792E-02
170	8.205E+05	1.066E+00	7.365E-02
170	7.990E+05	1.097E+00	1.054E-01
170	8.276E+05	1.094E+00	1.019E-01
170	8.521E+05	1.063E+00	7.084E-02
170	9.651E+05	1.085E+00	9.287E-02
170	9.703E+05	1.083E+00	9.135E-02
170	1.006E+06	1.089E+00	9.748E-02
170	9.497E+05	1.088E+00	9.634E-02
170	9.525E+05	1.108E+00	1.163E-01
170	9.666E+05	1.073E+00	8.057E-02
170	9.360E+05	1.088E+00	9.617E-02
170	9.431E+05	1.078E+00	8.617E-02
170	1.064E+06	1.037E+00	4.491E-02
171	2.908E+05	1.053E+00	6.120E-02
171	2.847E+05	1.063E+00	7.085E-02
171	2.960E+05	1.049E+00	5.662E-02
171	3.339E+05	1.030E+00	3.809E-02
171	3.212E+05	1.054E+00	6.195E-02
171	5.640E+05	1.091E+00	9.926E-02
171	5.664E+05	1.082E+00	9.042E-02
171	5.642E+05	1.096E+00	1.036E-01
171	5.315E+05	1.090E+00	9.791E-02

(Continued)

Table D-9 (cont'd)

171	5.550E+05	1.137E+00	1.451E-01
171	6.932E+05	1.079E+00	8.723E-02
171	6.993E+05	1.076E+00	8.365E-02
171	7.044E+05	1.073E+00	8.114E-02
171	7.183E+05	1.058E+00	6.588E-02
171	7.338E+05	1.056E+00	6.421E-02
171	8.941E+05	1.105E+00	1.133E-01
171	8.953E+05	1.096E+00	1.042E-01
171	9.107E+05	1.102E+00	1.104E-01
171	9.018E+05	1.117E+00	1.252E-01
171	9.600E+05	1.124E+00	1.317E-01
171	1.034E+06	1.106E+00	1.141E-01
171	1.023E+06	1.106E+00	1.141E-01
171	1.039E+06	1.104E+00	1.119E-01
171	1.037E+06	1.097E+00	1.052E-01
171	1.010E+06	1.101E+00	1.092E-01
171	1.148E+06	1.112E+00	1.200E-01
171	1.103E+06	1.115E+00	1.229E-01
171	1.102E+06	1.104E+00	1.121E-01
171	1.109E+06	1.129E+00	1.369E-01
171	1.082E+06	1.089E+00	9.665E-02
179	5.835E+05	9.236E-01	6.842E-02
179	6.269E+05	8.908E-01	1.011E-01
179	5.893E+05	8.923E-01	9.968E-02
179	6.187E+05	9.419E-01	5.003E-02
179	5.856E+05	8.342E-01	1.578E-01
179	7.449E+05	9.529E-01	3.902E-02
179	7.528E+05	9.252E-01	6.681E-02
179	7.631E+05	9.212E-01	7.077E-02
179	7.235E+05	9.080E-01	8.396E-02
179	7.337E+05	8.889E-01	1.031E-01
179	9.398E+05	8.858E-01	1.062E-01
179	9.155E+05	9.073E-01	8.469E-02
179	9.308E+05	9.285E-01	6.343E-02
179	8.930E+05	2.822E-01	7.097E-01
180	9.001E+05	8.809E-01	1.110E-01
180	1.046E+06	8.817E-01	1.103E-01
180	1.068E+06	8.892E-01	1.027E-01
180	1.080E+06	8.851E-01	1.068E-01
180	1.093E+06	8.787E-01	1.132E-01
180	1.071E+06	8.801E-01	1.118E-01
180	2.383E+05	9.296E-01	6.232E-02
180	2.255E+05	9.317E-01	6.025E-02
180	2.584E+05	8.921E-01	9.986E-02
180	2.414E+05	8.785E-01	1.135E-01
180	2.532E+05	8.476E-01	1.444E-01
180	6.092E+05	9.523E-01	3.963E-02
180	4.600E+05	9.367E-01	5.524E-02
180	4.795E+05	9.209E-01	7.104E-02
180	5.141E+05	9.243E-01	6.765E-02
181	4.818E+05	8.691E-01	1.229E-01
181	6.232E+05	9.390E-01	5.297E-02
181	6.267E+05	9.223E-01	6.971E-02
181	6.243E+05	9.472E-01	4.475E-02
181	6.253E+05	9.042E-01	8.778E-02
181	6.271E+05	9.362E-01	5.580E-02
181	6.859E+05	9.199E-01	7.208E-02
181	8.208E+05	9.038E-01	8.813E-02
181	7.963E+05	9.057E-01	8.626E-02
181	7.733E+05	6.259E-01	3.660E-01
181	7.738E+05	9.278E-01	6.419E-02

(Continued)

Table D-9 (cont'd)

186	2.690E+05	7.394E-01	2.526E-01
186	2.914E+05	7.413E-01	2.506E-01
186	2.673E+05	7.385E-01	2.535E-01
186	2.752E+05	7.034E-01	2.886E-01
186	2.822E+05	7.190E-01	2.730E-01
186	5.115E+05	7.052E-01	2.868E-01
186	5.335E+05	8.375E-01	1.545E-01
186	5.049E+05	7.649E-01	2.271E-01
186	5.075E+05	7.781E-01	2.138E-01
186	4.803E+05	7.937E-01	1.982E-01
188	8.555E+05	9.283E-01	6.368E-02
188	8.654E+05	9.340E-01	5.793E-02
188	8.694E+05	9.428E-01	4.913E-02
188	8.336E+05	9.374E-01	5.453E-02
188	8.303E+05	9.363E-01	5.570E-02
188	1.024E+06	1.213E+00	2.211E-01
188	1.018E+06	9.456E-01	4.635E-02
188	1.047E+06	9.605E-01	3.145E-02
188	1.025E+06	9.394E-01	5.257E-02
188	1.028E+06	9.548E-01	3.718E-02
187	2.917E+05	8.048E-01	1.872E-01
187	2.905E+05	7.890E-01	2.030E-01
187	2.459E+05	7.933E-01	1.986E-01
187	2.664E+05	8.024E-01	1.896E-01
187	2.958E+05	7.191E-01	2.728E-01
187	5.555E+05	9.942E-01	2.190E-03
187	5.836E+05	1.025E+00	3.277E-02
187	6.102E+05	1.007E+00	1.542E-02
187	5.891E+05	1.035E+00	4.345E-02
187	5.654E+05	1.005E+00	1.256E-02
187	7.381E+05	9.503E-01	4.165E-02
187	8.247E+05	9.399E-01	5.207E-02
187	8.260E+05	1.031E+00	3.857E-02
187	7.943E+05	1.019E+00	2.723E-02
188	1.028E+06	9.094E-01	8.256E-02
188	1.039E+06	9.170E-01	7.500E-02
188	1.017E+06	9.364E-01	5.561E-02
188	1.010E+06	9.323E-01	5.966E-02
188	1.046E+06	9.195E-01	7.246E-02
188	1.177E+06	9.101E-01	8.182E-02
188	1.195E+06	9.114E-01	8.055E-02
188	1.247E+06	9.201E-01	7.191E-02
188	1.177E+06	9.139E-01	7.811E-02
188	1.211E+06	9.125E-01	7.943E-02
172	2.488E+05	1.050E+00	5.780E-02
172	2.485E+05	1.041E+00	4.904E-02
172	2.574E+05	1.059E+00	6.700E-02
172	2.832E+05	1.043E+00	5.104E-02
172	3.124E+05	1.097E+00	1.052E-01
172	4.840E+05	1.094E+00	1.025E-01
172	4.924E+05	9.840E-01	7.947E-03
172	5.039E+05	1.003E+00	1.122E-02
172	5.115E+05	1.039E+00	4.665E-02
172	5.868E+05	1.065E+00	7.272E-02
172	5.600E+05	1.026E+00	3.427E-02
172	5.955E+05	1.024E+00	3.157E-02
172	7.150E+05	1.027E+00	3.473E-02
172	6.643E+05	1.037E+00	4.539E-02
172	6.471E+05	1.061E+00	6.857E-02
172	6.832E+05	1.074E+00	8.245E-02
172	6.631E+05	1.036E+00	4.369E-02

(Continued)

Table D-9 (cont'd)

173	6.893E+05	1.079E+00	8.733E-02
173	7.515E+05	1.102E+00	1.098E-01
173	6.838E+05	1.080E+00	8.793E-02
173	7.429E+05	1.135E+00	1.426E-01
173	7.325E+05	1.125E+00	1.332E-01
174	6.668E+05	1.077E+00	8.466E-02
174	7.166E+05	1.043E+00	5.105E-02
174	7.271E+05	1.067E+00	7.525E-02
174	7.125E+05	1.056E+00	6.444E-02
174	7.522E+05	1.089E+00	9.664E-02
173	2.246E+05	1.004E+00	1.242E-02
173	2.210E+05	1.003E+00	1.112E-02
173	2.259E+05	1.014E+00	2.243E-02
173	2.285E+05	1.020E+00	2.753E-02
173	2.402E+05	9.882E-01	3.731E-03
173	4.046E+05	1.016E+00	2.385E-02
173	4.186E+05	9.256E-01	6.635E-02
173	4.402E+05	1.020E+00	2.761E-02
173	4.492E+05	9.587E-01	3.326E-02
173	4.568E+05	9.613E-01	3.069E-02
173	5.327E+05	1.036E+00	4.370E-02
173	5.209E+05	1.066E+00	7.388E-02
173	5.228E+05	1.059E+00	6.727E-02
173	4.915E+05	1.034E+00	4.190E-02
173	5.281E+05	1.056E+00	6.410E-02
173	6.274E+05	1.124E+00	1.320E-01
173	6.127E+05	1.099E+00	1.072E-01
173	6.205E+05	1.123E+00	1.312E-01
173	6.243E+05	1.155E+00	1.635E-01
173	6.223E+05	1.090E+00	9.763E-02
173	6.723E+05	1.067E+00	7.497E-02
173	6.608E+05	1.097E+00	1.050E-01
173	6.705E+05	1.091E+00	9.940E-02
173	6.463E+05	1.074E+00	8.206E-02
173	6.652E+05	1.107E+00	1.151E-01
178	1.476E+06	1.078E+00	8.595E-02
178	1.521E+06	1.064E+00	7.213E-02
178	1.462E+06	1.053E+00	6.103E-02
178	1.498E+06	1.058E+00	6.614E-02
178	1.380E+06	1.060E+00	6.846E-02
174	2.587E+05	9.193E-01	7.271E-02
174	2.704E+05	9.178E-01	7.421E-02
174	2.510E+05	9.351E-01	5.689E-02
174	2.682E+05	9.103E-01	8.168E-02
174	2.686E+05	9.325E-01	5.943E-02
174	4.555E+05	9.968E-01	4.841E-03
174	4.519E+05	9.930E-01	1.007E-03
174	4.506E+05	9.933E-01	1.300E-03
174	4.750E+05	9.675E-01	2.445E-02
174	5.096E+05	9.505E-01	4.151E-02
174	8.145E+05	1.141E+00	1.491E-01
174	8.593E+05	1.064E+00	7.219E-02
174	8.629E+05	1.181E+00	1.890E-01
174	8.376E+05	1.093E+00	1.010E-01
174	7.959E+05	1.038E+00	4.648E-02
178	4.598E+05	1.080E+00	8.831E-02
178	4.616E+05	1.069E+00	7.747E-02
178	4.645E+05	1.069E+00	7.686E-02
178	4.531E+05	1.080E+00	8.764E-02
178	4.483E+05	1.075E+00	8.271E-02
178	1.024E+06	1.069E+00	7.727E-02

(Continued)

Table D-9 (cont'd)

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178     9.913E+05      1.066E+00      7.416E-02
178     1.002E+06      1.065E+00      7.255E-02
178     9.994E+05      1.081E+00      8.874E-02
178     1.086E+06      1.076E+00      8.357E-02
178     6.931E+05      1.243E+00      2.515E-01
178     6.928E+05      1.208E+00      2.163E-01
178     6.865E+05      1.201E+00      2.086E-01
178     6.803E+05      1.195E+00      2.026E-01
178     7.064E+05      1.216E+00      2.245E-01
178     8.184E+05      1.146E+00      1.541E-01
178     8.156E+05      1.118E+00      1.259E-01
178     8.335E+05      1.130E+00      1.384E-01
178     8.122E+05      1.126E+00      1.337E-01
178     8.146E+05      1.126E+00      1.344E-01
STANDARD DEVIATION= 2.495E-01
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APPENDIX E

COOLING TOWER AND BACKGROUND NOISE DATA

The data from the real time analyzer are listed in Tables E-1 and E-2. The data are presented in order for the octave bands from 63 Hz to 8 kHz and for the linear and A-weighted overall levels. The first 31 rows of numbers in each column are the measured noise levels for the 31 tests described in Section 5.4 and noted in Table 5.4-1. Rows 32-41 are the measured background noise levels measured at different times during the data acquisition period.

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TABLE E-1

MEASURED OCTAVE BAND NOISE LEVELS, dB*

63 Hz Location		125 Hz Location		250 Hz Location	
#1	#2	#1	#2	#1	#2
74.0	80.8	74.8	81.0	71.8	79.3
83.5	94.8	89.3	96.5	83.5	95.5
73.3	80.3	74.5	80.0	73.5	79.8
82.5	94.8	88.3	96.3	83.5	95.0
74.8	79.0	75.8	81.2	73.0	79.5
84.3	95.0	90.3	96.8	85.0	95.5
74.5	78.3	75.5	79.8	75.0	78.8
83.0	95.5	90.0	96.5	83.8	95.3
74.0	79.3	74.0	79.0	72.0	77.8
84.0	97.5	89.5	98.0	83.5	96.5
73.0	78.5	74.3	79.3	73.0	78.5
84.5	97.3	89.5	97.3	85.0	96.0
74.0	78.8	75.0	81.2	72.3	78.5
84.8	96.5	89.8	98.3	84.0	96.3
74.5	79.0	75.5	80.8	74.3	78.0
84.5	96.5	90.3	97.3	84.8	96.0
72.8	78.8	75.5	81.0	72.8	79.3
83.5	96.5	89.3	97.8	84.0	95.5
77.5	88.0	80.5	87.3	76.3	85.0
77.8	87.5	80.5	86.3	77.0	85.0
76.5	86.8	78.5	85.5	74.5	83.8
77.0	86.5	80.0	87.0	76.3	85.0
77.5	87.3	81.5	88.0	77.3	87.5
75.3	85.5	77.0	85.5	73.0	83.8
77.3	87.8	80.0	87.3	76.0	84.5
77.0	87.8	80.3	87.0	76.0	84.5
77.0	87.3	79.8	86.8	75.5	85.0
77.3	87.8	80.0	87.0	75.8	85.3
76.0	87.0	78.5	86.3	74.5	84.0
76.3	87.3	79.0	86.5	74.5	84.3
76.3	86.5	78.8	86.0	74.3	84.5
73.0		77.8		63.3	
72.3		71.5		66.8	
71.5		78.3		66.3	
73.8		70.5		66.3	
73.0		70.8		67.0	
71.0		78.0		65.8	
70.8		75.3		62.8	
69.8		68.3		63.8	
69.3		75.0		68.5	
71.0		75.0		67.5	

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*dB re 20 μN/m^2

(Continued)

Table E-1 (cont'd)

500 Hz Location		1000 Hz Location		2000 Hz Location	
#1	#2	#1	#2	#1	#2
71.8	78.8	71.0	75.8	67.3	70.5
76.3	91.3	75.8	90.8	70.3	88.3
72.5	78.8	71.8	75.5	69.0	71.8
75.5	91.0	74.5	90.0	69.8	87.5
72.8	78.5	72.0	75.8	67.5	71.0
76.5	91.0	75.8	90.5	70.5	88.5
72.5	77.5	72.3	74.5	68.0	71.8
76.0	90.5	74.0	89.8	69.8	87.3
71.3	75.5	71.3	73.8	67.5	69.0
77.3	92.5	75.5	90.0	69.0	87.5
72.3	76.8	71.5	73.5	68.3	71.0
77.0	92.0	76.0	89.5	68.7	86.5
72.0	76.5	70.0	73.8	67.0	70.5
80.0	92.8	82.0	90.5	68.5	87.5
73.5	76.0	72.3	74.0	69.0	71.8
78.0	92.3	77.3	89.5	69.0	87.3
73.0	78.5	71.5	74.0	67.8	68.5
77.5	93.0	75.0	90.0	69.8	86.8
72.8	82.5	72.0	82.5	67.5	75.0
74.0	82.5	73.0	82.0	68.7	74.0
72.8	80.5	71.3	81.2	68.0	75.8
72.5	81.2	71.3	83.5	65.5	75.8
73.3	83.3	73.3	86.5	68.5	76.8
70.8	80.8	70.3	80.0	67.0	75.3
73.0	82.5	72.8	82.5	68.3	74.8
72.8	82.8	72.5	82.5	68.0	74.5
72.8	83.3	72.5	82.5	68.7	74.5
73.3	83.0	72.8	82.0	68.5	74.3
71.3	80.3	70.5	82.0	67.3	76.0
71.5	81.5	70.3	82.0	67.0	76.3
71.8	81.0	71.0	81.2	67.3	75.5
57.0		57.0		52.5	
62.5		62.0		58.8	
56.2		57.3		52.8	
63.0		62.0		59.3	
64.3		63.0		59.3	
58.0		56.5		52.5	
54.8		56.0		51.8	
62.0		62.3		58.0	
64.5		57.8		54.0	
64.8		58.8		57.3	

(Continued)

Table E-1 (cont'd)

4000 Hz Location		8000 Hz Location		16000 Hz Location	
#1	#2	#1	#2	#1	#2
64.0	69.8	61.5	66.8	54.5	60.0
63.3	78.0	59.3	73.0	51.8	66.0
66.0	70.5	63.8	69.5	57.5	64.5
64.8	78.3	61.5	74.0	54.8	67.3
63.5	69.5	60.3	67.0	53.3	59.0
62.8	79.0	58.3	73.3	50.8	65.3
65.0	70.5	62.5	69.5	57.0	63.0
64.0	79.3	60.5	74.3	54.3	67.0
64.3	66.8	61.0	65.5	55.0	57.8
63.3	80.8	58.0	75.3	51.0	68.3
65.0	70.5	62.0	70.5	55.5	65.0
63.0	80.8	58.8	76.0	51.8	69.3
63.0	69.0	58.8	67.0	51.3	59.3
61.5	80.5	56.0	74.5	47.8	67.3
64.3	70.3	61.0	69.5	54.0	63.5
62.8	80.8	57.8	75.5	50.5	68.5
64.0	64.3	61.0	57.3	54.3	43.5
63.0	74.8	59.0	65.3	51.5	60.0
62.8	66.5	58.5	58.5	51.5	50.0
65.0	67.5	60.8	60.3	53.8	51.0
64.8	72.0	62.5	70.3	56.5	64.5
59.8	69.0	54.0	63.0	45.8	59.0
64.3	72.0	61.8	69.5	55.3	63.5
64.0	71.8	61.0	69.5	54.8	63.3
64.0	66.8	60.8	59.3	53.8	50.3
64.0	67.0	61.3	59.3	54.0	50.8
64.0	67.3	61.8	60.8	54.8	50.8
65.0	67.5	62.0	59.0	55.3	50.5
63.3	72.0	60.8	69.5	55.0	63.5
63.5	72.5	61.3	69.0	54.8	63.5
63.5	71.5	61.3	69.0	54.5	63.5
50.3		43.5		34.3	
57.8		51.8		40.8	
50.5		43.7		34.3	
59.0		53.5		42.0	
57.8		52.3		39.5	
50.5		42.8		32.3	
49.5		42.5		34.3	
56.8		51.0		38.5	
52.0		47.0		39.8	
52.5		45.5		39.8	

TABLE E-2

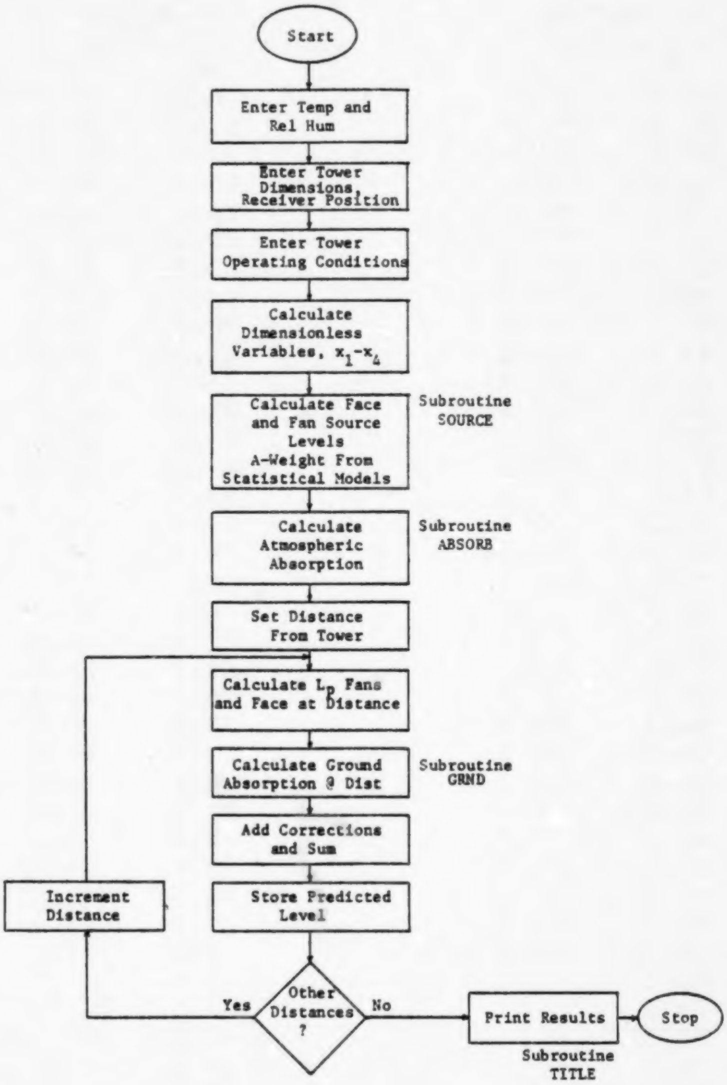
MEASURED OVERALL NOISE LEVELS, dB*

Linear Location		A-Weighted Location	
#1	#2	#1	#2
82.0	87.5	75.5	80.8
92.3	102.0	81.2	95.5
82.0	87.5	76.5	81.8
91.0	102.0	80.8	95.0
82.5	87.0	76.5	80.8
93.0	102.5	82.0	95.5
83.3	86.3	76.8	80.5
92.0	102.0	80.8	95.0
81.8	86.5	75.8	79.0
93.5	103.3	81.2	95.5
81.8	86.3	76.3	80.0
93.0	103.3	81.8	95.0
82.0	87.3	75.3	79.8
93.7	103.3	84.8	95.8
83.0	86.5	77.3	79.5
93.5	103.0	82.5	95.5
82.0	86.5	76.3	79.8
92.5	103.0	81.2	95.3
86.0	93.3	76.3	86.0
86.3	93.3	77.5	85.5
84.8	92.5	76.3	84.8
85.0	93.0	75.8	86.8
86.3	94.8	77.8	89.5
84.0	92.3	75.5	84.5
86.0	93.3	76.8	85.8
86.0	93.0	77.0	85.5
85.8	92.8	77.0	86.0
85.5	93.5	77.5	85.8
84.8	92.8	76.0	85.5
84.8	93.0	75.8	85.3
85.3	92.3	76.0	85.0
80.0		65.0	
76.8		67.5	
79.5		65.3	
78.0		67.8	
78.0		68.3	
79.8		64.8	
77.5		62.8	
75.3		66.3	
78.0		66.8	
79.0		66.5	

---

*dB re 20 μN/m^2

Dwg. 7697A90



Start
Enter Temp and Rel Hum
Enter Tower Dimensions, Receiver Position
Enter Tower Operating Conditions
Calculate Dimensionless Variables, x_1-x_4
Calculate Face and Fan Source Levels A-Weight From Statistical Models
Subroutine SOURCE
Calculate Atmospheric Absorption
Subroutine ABSORB
Set Distance From Tower
Calculate L_p Fans and Face at Distance
Calculate Ground Absorption @ Dist
Subroutine GRND
Add Corrections and Sum
Store Predicted Level
Increment Distance
Other Distances ?
Yes
No
Print Results
Subroutine TITLE
Stop

Figure F-1. Flow Diagram for Main Program TOWER.

APPENDIX F

NOISE PREDICTION COMPUTER MODEL DOCUMENTATION

This appendix explains the use of the Fortran IV program TOWER for predicting the noise levels of the TVA wet/dry cooling tower. The program and subroutine source codes are presented in Appendix G.

F.1 PROGRAM STRUCTURE

A flow diagram of TOWER is presented in Figure F-1. The program solicits input data, in the format described below, including (1) the ambient air temperature and relative humidity, (2) the cooling tower size, (3) the cooling tower operating conditions and (4) the receiver height and distance from the cooling tower. Flow diagrams of the four subroutines, ABSORB, GRND, SOURCE and TITLE, are shown in Figures F-2 through F-5. These program segments are all described below.

F.2 SUMMARY OF PROGRAMS

The software consists of a main calling program, TOWER, and four subroutines. The subroutines are used to perform either repetitive or utility tasks. The following is an alphabetical listing of all the programs listed in Appendix G along with descriptions of their functions.

Program Name	Description
ABSORB	Computes excess atmospheric attenuation per unit distance for any temperature, relative humidity and frequency (octave bands). Uses procedure contained in Reference 3, Section 5.0 of this report.

Dwg. 7697A91

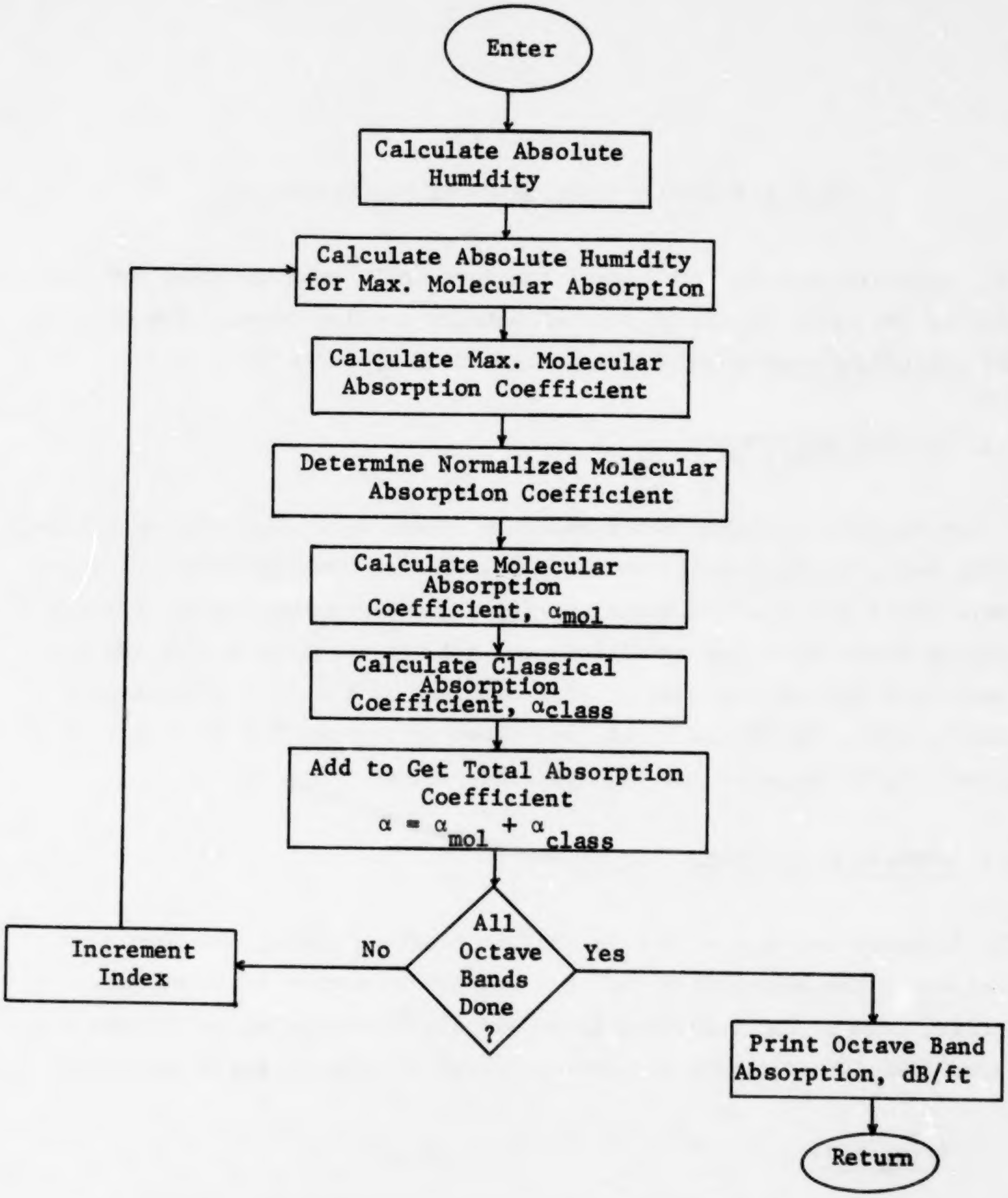

Enter
Calculate Absolute Humidity
Calculate Absolute Humidity for Max. Molecular Absorption
Calculate Max. Molecular Absorption Coefficient
Determine Normalized Molecular Absorption Coefficient
Calculate Molecular Absorption Coefficient, α_{mol}
Calculate Classical Absorption Coefficient, α_{class}
Add to Get Total Absorption Coefficient $\alpha = \alpha_{mol} + \alpha_{class}$
All Octave Bands Done ?
No
Yes
Increment Index
Print Octave Band Absorption, dB/ft
Return

Figure F-2. Flow Diagram for Subroutine ABSORB.

Dwg. 7697A92

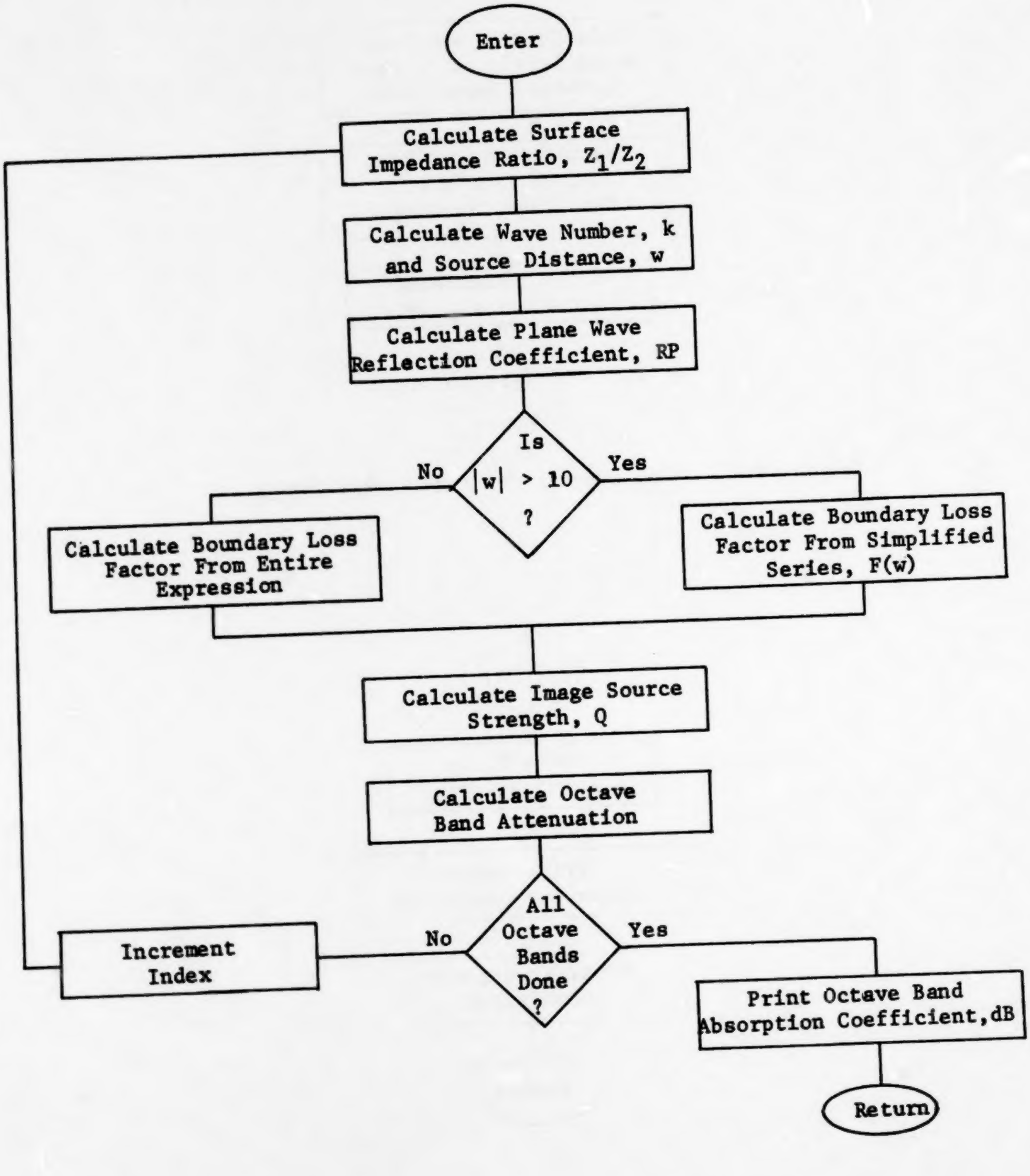

Enter
Calculate Surface Impedance Ratio, Z_1/Z_2
Calculate Wave Number, k and Source Distance, w
Calculate Plane Wave Reflection Coefficient, RP
Is |w| > 10 ?
No
Yes
Calculate Boundary Loss Factor From Entire Expression
Calculate Boundary Loss Factor From Simplified Series, F(w)
Calculate Image Source Strength, Q
Calculate Octave Band Attenuation
All Octave Bands Done ?
No
Yes
Increment Index
Print Octave Band Absorption Coefficient, dB
Return

Figure F-3. Flow Diagram for Subroutine GRND.

Dwg. 7697A93

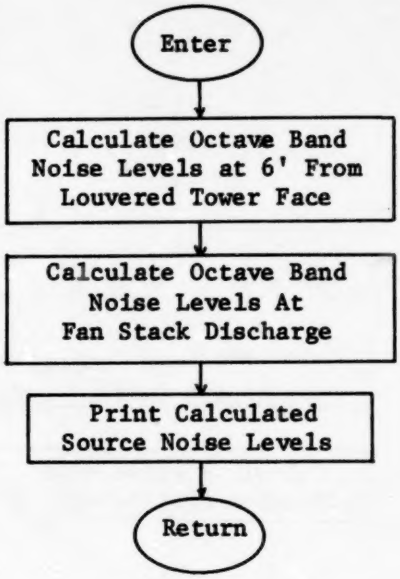

Enter
Calculate Octave Band Noise Levels at 6' From Louvered Tower Face
Calculate Octave Band Noise Levels At Fan Stack Discharge
Print Calculated Source Noise Levels
Return

Figure F-4. Flow Diagram for Subroutine SOURCE.

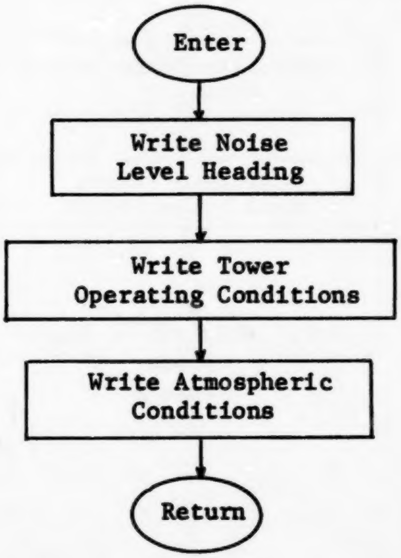

Enter
Write Noise Level Heading
Write Tower Operating Conditions
Write Atmospheric Conditions
Return

Figure F-5. Flow Diagram for Subroutine TITLE.

Program Name	Description
GRND	Computes excess ground attenuation as a function of source and receiver heights, frequency (octave bands) and distance from the tower over flat ground. Based on procedures contained in References 4, 5, 6, and 8 listed in Section 5.0.
SOURCE	Computes the octave band, linear and A-weighted source sound levels at the fan stack discharge and near the louvered face for any fan speed, total water flow rate, dry flow percentage and blade pitch. Based on results of the regression analysis in Section 5.4.
TITLE	Utility program which outputs table headings and relevant program input parameters.
TOWER	Main calling program which solicits data input, calculates tower noise levels and converts data for atmospheric and ground attenuation.

F.3 INPUT DATA FORMAT

All variable input data are transmitted to the program TOWER via Fortran read statements. Two input data cards are required. Their format is as follows.

Card #1

Column No.	1	11	21	31	41	51
Variable	TH	TW	FS	BP	WR	DF
Format	F10.1	F10.1	F10.1	F10.1	F10.1	F10.1

TH = Tower height, ft

TW = Tower width, ft

FS = Fan speed, %

BP = Blade pitch, degrees

WR = Total water flow rate, gpm

DF = Dry flow percentage, %

TABLE F-1

SAMPLE OUTPUT FROM PROGRAM TOWER

```
TTTTTTTTTTTT    OOOOOOOO    WW        WW  EEEEEEEEEEEE  RRRRRRRRRRR
TTTTTTTTTTTT   OOOOOOOOOO   WW        WW  EEEEEEEEEEEE  RRRRRRRRRRRR
     TT        OO      OO   WW        WW  EE            RR        RR
     TT        OO      OO   WW        WW  EE            RR        RR
     TT        OO      OO   WW        WW  EE            RR        RR
     TT        OO      OO   WW   WW   WW  EEEEEEEE      RRRRRRRRRRRR
     TT        OO      OO   WW  WWWW  WW  EEEEEEEE      RRRRRRRRRRR
     TT        OO      OO   WW WW  WW WW  EE            RR    RR
     TT        OO      OO   WWWW    WWWW  EE            RR     RR
     TT        OO      OO   WWW      WWW  EE            RR      RR
     TT        OOOOOOOOOO   WW        WW  EEEEEEEEEEEE  RR       RR
     TT         OOOOOOOO    WW        WW  EEEEEEEEEEEE  RR        RR


                         P R E D I C T E D   C O O L I N G   T O W E R   N O I S E   L E V E L S
                                   I N C L U D I N G   G R O U N D   A B S O R P T I O N

TOWER OPERATING AND TEST CONDITIONS--
                     FAN SPEED(PERCENT)  =   100.0    BLADE PITCH(DEG) =       1.0
                     TOT. WATER FLOW(GPM)= 20000.0    DRY FLOW(PERCENT)=        .0
                     TEMPERATURE(DEG F)  =    76.0    REL HUM(PERCENT) =      60.0

                                            OCTAVE BAND CENTER FREQUENCIES, HZ
DIST(FT)    LINEAR     A-WGT        63        125        250        500       1000       2000       4000       8000

   100.      94.7       86.9       91.1       88.2       87.3       81.9       80.8       79.9       78.6       76.9
   200.      83.9       70.0       81.9       77.0       72.8       65.7       61.7       59.6       55.6       57.0
   300.      80.5       66.6       78.0       75.7       69.5       61.2       58.8       56.6       52.5       53.8
   400.      77.9       64.1       76.4       73.1       67.2       58.2       55.6       54.6       50.4       51.6
   500.      75.8       61.9       73.4       70.9       65.1       55.2       52.7       52.9       48.6       49.5
   600.      80.3       72.0       70.6       75.0       71.9       63.5       65.4       65.9       61.6       62.6
   700.      73.9       61.2       71.3       69.0       63.3       53.8       47.2       54.8       50.9       51.1
   800.      72.5       59.6       70.0       67.5       61.7       52.1       46.4       53.0       49.8       49.8
   900.      71.3       58.7       68.9       66.2       60.2       50.9       43.9       53.0       48.7       49.7
  1000.      70.2       57.8       67.9       65.0       58.8       49.2       43.1       52.6       47.4       47.7
  1400.      66.7       54.1       64.7       60.9       54.1       44.6       37.7       47.2       44.9       43.7
  1800.      63.7       51.6       62.3       57.8       50.5       40.7       33.4       47.3       42.7       40.8
  2200.      61.7       48.8       60.3       54.8       47.3       37.4       30.0       44.8       40.8       37.8
  2600.      59.8       46.3       58.6       52.3       44.6       35.3       27.2       41.7       38.7       35.3
  3000.      58.1       44.2       57.1       50.1       42.3       33.1       24.9       39.1       37.8       32.9
  3400.      56.7       42.4       55.6       48.0       40.3       31.1       22.7       36.8       36.6       30.1
  3800.      55.3       34.8       53.8       38.1       38.5       29.2       20.8       34.7       35.1       29.3
  4200.      54.2       38.4       53.5       44.3       38.8       27.8       19.1       32.8       33.6       27.3
  4600.      53.1       37.3       52.5       42.6       35.4       26.2       17.8       31.1       31.7       24.7
  5000.      52.1       36.7       51.6       41.0       33.9       24.8       16.2       29.8       30.1       22.6


          OCTAVE BAND AND LINEAR TOWER SOURCE NOISE LEVELS  IN DB

                          BAND CENTER FREQUENCIES,HZ
           63      125      250      500     1000     2000     4000     8000      LIN

 SIDE     81.2     88.6     81.8     76.9     76.9     67.9     61.0     64.9     90.4
 FAN      96.1     95.6     95.2     89.4     89.4     89.1     85.2     86.9    101.6


      OCTAVE BAND ATMOSPHERIC ABSORPTION COEFFICIENTS IN DB PER 1000 FT
          FOR TEMP=  76 DEGREES F AND RELATIVE HUMIDITY=  60 PERCENT

            63     125 BAND CENTER FREQUENCIES, HZ 2000   4000   8000
                          250    500   1000
          .000    .001   .002   .004   .039   .163   .674  2.790
```

(Continued)

Card #2

Column No.	1	11
Variable	TEMP	RELHUM
Format	F10.1	F10.1

TEMP = Ambient air temperature, °F
RELHUM = Ambient air relative humidity, %

All necessary data conversions are performed internally in the program code. Consistent output data will always be generated as long as the input data is provided in the units specified above.

The program automatically calculates the receiver sound levels at distances of 100 to 5000 ft from the cooling tower. Increments of 100 ft are used from 100 to 1000 ft; increments of 400 ft are used from there to 5000 ft. The size of the increments can be changed by changing the values of DINC in lines 67 and 139 in program TOWER. (See Appendix G for listings.) The number of distances at which the receiver noise level is calculated is controlled by the integer variable IRPT. It is currently set to 20; it can be changed on line 64 of TOWER if desired. If values of IRPT > 20 are desired, it will be necessary to increase the value of the subscripted values of many of the dimensioned variables (lines 21-23 in TOWER).

Most of the key names used in TOWER and its subroutines are identified in comment statements near the beginning of each section of code. Where appropriate, the units of the quantity are also identified.

F.4 SAMPLE OUTPUT LISTINGS

A new sample copy of the output generated by TOWER is presented in Table F-1. The table is somewhat self-explanatory, but it will be briefly reviewed.

Table F-1 (cont'd)

```
                     P R E D I C T E D   C O O L I N G   T O W E R   N O I S E   L E V E L S

TOWER OPERATING AND TEST CONDITIONS--
               FAN SPEED(PERCENT)  =    100.0    BLADE PITCH(DEG) =      1.0
               TOT. WATER FLOW(GPM)= 20000.0    DRY FLOW(PERCENT)=       .0
               TEMPERATURE(DEG F)  =     76.0    REL HUM(PERCENT) =     60.0

DIST(FT)    LINEAR     AWGT        63 OCTAVE BAND CENTER FREQUENCIES, HZ
                                          125        250        500       1000       2000       4000       8000
   100.      81.8      83.7       84.1       88.1       85.9       79.4       79.5       79.1       76.3       76.7
   200.      78.2      68.5       76.1       74.6       71.6       64.3       61.2       59.2       65.1       66.3
   300.      76.2      65.1       72.7       71.5       68.2       60.9       57.7       55.8       51.6       54.7
   400.      73.8      62.6       70.2       69.0       65.7       58.4       55.3       53.3       49.1       50.0
   500.      71.8      60.7       68.3       67.1       63.8       56.5       53.3       51.9       47.1       47.0
   600.      77.1      70.9       71.6       71.9       70.7       65.0       49.9       49.9       60.3       60.7
   700.      70.3      60.2       66.9       65.7       62.7       56.1       48.3       53.2       49.0       49.1
   800.      69.2      59.0       65.2       64.6       61.6       55.0       47.2       52.0       47.7       47.7
   900.      68.1      57.9       64.2       63.5       60.5       53.9       46.2       51.0       46.7       46.9
  1000.      67.2      57.0       63.3       62.6       59.8       53.0       45.2       50.1       45.7       45.2
  1400.      65.3      54.0       60.3       59.6       56.6       50.1       42.1       47.1       42.5       41.6
  1800.      62.1      51.7       58.2       57.6       54.6       47.6       40.1       44.6       40.0       38.6
  2200.      60.9      49.9       56.5       55.8       52.8       46.3       38.9       43.0       38.0       35.0
  2600.      58.9      48.9       56.0       54.3       51.3       44.7       36.9       41.5       36.3       32.6
  3000.      57.7      47.1       53.8       53.1       50.1       43.6       35.6       40.2       34.6       30.1
  3400.      56.6      45.9       52.7       52.0       49.0       42.9       34.5       39.0       33.9       27.9
  3800.      55.6      44.9       51.7       51.0       48.0       41.9       33.5       38.0       32.2       25.8
  4200.      54.7      44.0       50.8       50.2       47.2       40.5       32.7       37.1       31.1       23.8
  4600.      53.9      43.2       50.0       49.3       46.3       39.7       31.9       36.2       30.0       21.9
  5000.      53.2      42.4       49.3       48.7       45.7       39.0       31.1       35.9       29.0       20.1
```

```
  OCTAVE BAND GROUND ATTENUATION IN DB FOR FAN STACK RADIATED NOISE
             FITTING PARAMETER SIGMA =   200.0 CGS UNITS
DISTANCE           BAND CENTER FREQUENCIES,HZ
   FT       63     125     250     500    1000    2000    4000    8000
   100.    4.9     1.9     2.1     1.8     1.3      .8      .4      .2
   200.    5.3     4.0     1.0     1.7      .9      .9      .4      .6
   300.    5.3     4.3     1.3      .8      .9      .8      .8     1.1
   400.    5.2     4.2     1.6      .3      .5     1.2     1.3     1.5
   500.    5.1     3.9     1.5     -.7     1.2      .9     1.8     1.7
   600.    5.0     3.7     1.2    -1.4      .6     1.5     1.3     1.9
   700.    4.9     3.4      .8    -2.0     1.2     1.6     1.9     1.9
   800.    4.8     3.1      .3    -2.5     1.5     1.0     2.1     2.1
   900.    4.7     2.8     -.1    -2.9     1.3     2.1     2.1     2.2
  1000.    4.6     2.5     -.6    -3.4      .8     2.4     1.7     2.5
  1400.    4.3     1.4    -2.3    -5.1    -1.6     2.2     2.0     2.5
  1800.    4.0      .3    -3.8    -6.5    -3.7     2.6     2.6     2.6
  2200.    3.8     -.8    -5.2    -7.8    -5.3     1.6     2.9     2.8
  2600.    3.5    -1.8    -6.5    -8.9    -6.7      .3     2.8     2.8
  3000.    3.3    -2.8    -7.4    -9.9    -7.9    -1.0     3.0     2.8
  3400.    3.1    -3.8    -8.4   -10.8    -8.9    -2.2     3.2     2.2
  3800.    2.9    -4.7    -9.2   -11.7    -9.7    -3.2     2.9     3.5
  4200.    2.6    -5.6   -10.0   -12.4   -10.6    -5.2     2.4     3.6
  4600.    2.4    -6.5   -10.7   -13.1   -11.3    -6.1     1.8     2.8
  5000.    2.2    -7.3   -11.4   -13.8   -12.0    -6.8     1.1     3.6
```

```
  OCTAVE BAND GROUND ATTENUATION IN DB FOR NOISE FROM THE TOWER FACE
             FITTING PARAMETER SIGMA =   200.0 CGS UNITS
DISTANCE           BAND CENTER FREQUENCIES,HZ
   FT       63     125     250     500    1000    2000    4000    8000
   100.    5.4     4.6     1.3      .6      .5      .6      .8      .8
   200.    5.4     4.4     2.0    -1.0      .6      .9     1.5     1.6
   300.    5.4     4.1     1.2    -2.2     1.3      .9     1.4     2.1
   400.    5.3     3.7      .1    -3.4      .0     2.0     2.1     2.2
   500.    5.2     3.3    -1.0    -4.5    -1.6     2.0     2.2     2.4
   600.    5.2     3.0    -2.0    -5.5    -3.1     2.6     1.6     2.7
   700.    5.1     2.7    -3.0    -6.4    -4.3     2.2     3.2     2.6
   800.    5.1     2.4    -4.0    -7.2    -5.4     1.5     2.8     2.7
   900.    5.0     2.0    -4.9    -8.0    -6.3      .6     2.3     3.0
  1000.    5.0     1.7    -5.8    -8.8    -7.1     -.3     2.6     2.7
  1400.    4.8      .6    -8.7   -11.2    -9.8    -3.4     2.8     3.5
  1800.    4.6     -.6   -10.9   -13.1   -11.8    -5.8     1.2     2.6
  2200.    4.5    -1.8   -12.7   -14.7   -13.4    -7.7     -.6     3.2
  2600.    4.3    -2.9   -14.2   -16.0   -14.7    -9.2    -2.3     3.3
  3000.    4.1    -4.0   -15.4   -17.2   -15.8   -10.4    -3.7     2.7
  3400.    4.0    -5.1   -16.5   -18.2   -16.9   -11.5    -4.9     1.8
  3800.    3.8    -6.1   -17.4   -19.1   -17.8   -12.5    -6.0      .7
  4200.    3.6    -7.2   -18.3   -20.0   -18.6   -13.4    -6.9      .0
  4600.    3.5    -8.2   -19.1   -20.7   -19.4   -14.1    -7.8     -.9
  5000.    3.3    -9.2   -19.8   -21.4   -20.1   -14.9    -8.6    -1.7

@FIN
```

The first section of the output gives the predicted values of the octave band, linear and A-weighted noise levels at the receiver as a function of distance from the cooling tower, including the effects of ground attenuation. The program then prints the cooling tower source noise levels which were calculated from the fitted equations described in Section 6.0 for the particular tower operating condition selected. The program then prints out the calculated octave band atmospheric absorption coefficients in dB/ft for the input atmospheric conditions.

The next section of the output again prints octave band, linear and A-weighted noise levels as a function of receiver location, but this time without the ground absorption factors included. The third section of the output tabulates the octave band ground attenuation factors as a function of distance for the noise radiated from the fan stack and from the louvered face of the tower.

APPENDIX G

NOISE PREDICTION COMPUTER CODE

Preceding page blank

MAIN PROGRAM 'TOWER'

```
C       ****************************************************************
C       *                                                              *
C       *  PROGRAM PREDICTS THE SOUND PRESSURE LEVEL VS DISTANCE FROM  *
C       *  THE LOUVERED FACE OF THE TVA COOLING TOWER FOR SPECIFIED    *
C       *  TOWER OPERATING CONDITIONS                                  *
C       *                                                              *
C       *     CALLS:  SOURCE,ABSORB,GRND,TITLE                         *
C       *                                                              *
C       ****************************************************************
C
C          I         = RECEIVER POSITION INDEX
C          J         = OCTAVE BAND INDEX
C          CZ        = SPEED OF SOUND IN AIR, M/SEC
C          IRPT      = NO OF DISTANCES WHERE NOISE LEVELS ARE CALCULATED
C          DINC      = INCREMENTAL DISTANCE FOR NOISE LEVEL CALCULATIONS
C          DST(I)    = DISTANCE FROM TOWER, FT
C          DIS(I)    = DISTANCE FROM TOWER, M
C          GAT(J)    = GROUND ABSOPRTION - FROM TOWER FACE, DB
C          GAF(J)    = GROUND ABSORPTION - FROM FAN STACK, DB
C          S(I,J)    = RECEIVER NOISE LEVEL W/O GND ABSORPTION, DB
C          SW(I,J)   = RECEIVER NOISE LEVEL WITH GND ABSORPTION, DB
C          ALPHA(J)= ATMOSPHERIC ABSORPTION, DB
C          FSTD      = FAN STACK DIAMETER AT DISCHARGE, FT
C
        DIMENSION SL(20,8),SF(20,8),ALPHA(8),SLIN(20),SAWT(20),DST(20)
        DIMENSION S(20,8),GAT(20,8),GAF(20,8),TSL(8),TSF(8),AWT(8),IFRQ(8)
        DIMENSION SLW(20,8),SFW(20,8),SW(20,8),SLINW(20),SAWTW(20)
        DIMENSION AFC1(8),AFC2(8),        DIS(20),GT(8),GF(8)
        DATA IFRQ/63,125,250,500,1000,2000,4000,8000/
        DATA AFC1/4.,5.,7.,8.,19.,10.,10.,10./
        DATA AFC2/ 5.,7., 9.,11.,4*15./
        DATA AWT/-26.,-16.,-9.,-3.,0.,1.,1.,-1./
        SIGMA = 200.0
C
C
C       READ COOLING TOWER SIZE(FT)  AND OPERATING CONDITIONS
C
        READ(5,10) TH, TW, FS, BP, WR, DF
10      FORMAT(6F10.1)
C
C       READ TEMPERATURE AND RELATIVE HUMIDITY
C
        READ(5,20) TEMP, RELHUM
20      FORMAT(2F10.1)
        TH = TH*0.3048
        TW = TW*0.3048
```

```
C
C     CALCULATE DIMENSIONLESS VAR. AND MISC. FACTORS
C
      X1    = (FS-75.)*0.04
      X2    = (WR-18000.)*0.00025
      X3    = (DF-60.)*0.05
      X4    = BP*0.5
      CZ    = SQRT(1.4*32.2*53.3*(TEMP+460.))*0.3048
C
C     CALCULATE TOWER SOURCE LEVELS & CORRECTIONS
C
      CALL SOURCE(X1,X2,X3,X4,TSL,TSF)
      S1 = 0.
      S2 = 0.
      DO 25 J = 1,8
      S1 = S1+10.**(TSL(J)*0.1)
      S2 = S2+10.**(TSF(J)*0.1)
   25 CONTINUE
      SLL = 10.*ALOG10(S1)
      SLF = 10.*ALOG10(S2)
      CALL ABSORB(TEMP,RELHUM,ALPHA)
      IRPT = 20
      DST(1) = 100.0
      DIS(1) = DST(1)*0.3048
      DINC = 100.0
C
C     CALCULATE NOISE LEVELS AT DISTANCES
C
      PI    = 3.14159265
      HS    = 20.*0.3048
      HR    = 5.0*0.3048
      HF    = 55.0*0.3048
      FSTD = 36.4
      FST = FSTD**2/11.2
      DO 110  I = 1,IRPT
      A1    = TH/DIS(I)
      A2    = (TW*0.5)/DIS(I)
      ARG   = 2.*ATAN(A1)*ATAN(A2)/PI
      SPHRL = 10.*ALOG10(ARG)
      RECD = DIS(I)**2
      R1    = SQRT(RECD+(HS-HR)**2)
      R2    = SQRT(RECD+(HS+HR)**2)
      THETA= ATAN((HS+HR)/DIS(I))
      RR    = R2/R1
      DR    = R2-R1
      T1 = R1
      CALL GRND(R2,RR,DR,THETA,CZ,GT)
      DO 101 J=1,8
      GAT(I,J) = GT(J)
  101 CONTINUE
      R1    = SQRT(RECD+(HF-HR)**2)
      R2    = SQRT(RECD+(HF+HR)**2)
      THETA= ATAN((HF+HR)/DIS(I))
      RP    = R2/R1
      DR    = R2-R1
      T2 = R1
      CALL GRND(R2,RR,DR,THETA,C2,GF)
      DO 102 J = 1,8
      GAF(I,J) = GF(J)
  102 CONTINUE
      WRITE(6,35)
   35 FORMAT(//)
      SPHRF = 10.*ALOG10(FST/R1**2)
      SUML = 0.0
      SUMA = 0.0
      SUMLW = 0.
      SUMAW = 0.
      DO 105  J = 1,8
      PT = -ALPHA(J)/.3048
      TRM1 = (PT*T1)*.001
      TRM2 = (PT*T2)*.001
      SL(I,J) = TSL(J) + SPHRL + TRM1
      SF(I,J) = TSF(J) + SPHRF + TRM2
C
C           FAN RADIATION DIR. CORR, AFC1,AFC2
C
      DIFF = DST(I) - 150.0
      IF(DIFF .GT. 0..AND. DIFF .LT. 450.0) SF(I,J) = SF(I,J)-AFC2(J)
      IF(DIFF .GT. 450.0) SF(I,J) = SF(I,J)-AFC1(J)
      SLW(I,J) = SL(I,J) + GAT(I,J)
      SFW(I,J) = SF(I,J) + GAF(I,J)
C
C     CALCULATE OVERALL NOISE LEVELS
C
      X1 = 10.**(SL(I,J)*0.1)
      X2 = 10.**(SF(I,J)*0.1)
      Y1 = 10.**(SLW(I,J)*0.1)
      Y2 = 10.**(SFW(I,J)*0.1)
      IF(SL(I,J) .LE. 0.)  X1 = 1.
      IF(SF(I,J) .LE.0.) X2 = 1.
      IF(SL(I,J) .LE. 0. .AND. SF(I,J) .LE. 0.) GO TO 38
      S(I,J) = 10.*ALOG10(X1 + X2)
      GO TO 39
   38 S(I,J) = 0.
   39 WRITE(6,40) I,J,TSL(J),TSF(J),TRM1,TRM2,SPHRL,SPHRF,GAT(I,J),GAF(I
     1,J),SL(I,J),SF(I,J),S(I,J)
   40 FORMAT(1X,2I5,2F8.2,E11.2,E11.2,7F8.2)
      TMP = S(1,1)
      SUML = SUML+10.**(S(I,J)*0.1)
      ACOR = (S(I,J)+AWT(J))*0.1
      X3 = 10.**ACOR
      IF(ACOR .LE. 0.)  X3 = 0.
      SUMA = SUMA + X3
      IF(SLW(I,J) .LE. 0.) Y1 = 1.
      IF(SFW(I,J) .LE. 0.)  Y2 = 1.
      IF(SLW(I,J) .LE. 0. .AND. SFW(I,J) .LE. 0.)  GO TO 42
      SW(I,J) = 10.*ALOG10(Y1 + Y2)
      GO TO 43
 42   SW(I,J) = 0.
 43   SUMLW = SUMLW + 10.**(SW(I,J)*0.1)
      ACORW = (SW(I,J) + AWT(J))*0.1
      Y3 = 10.**ACORW
      IF(ACORW .LE. 0.)  Y3 = 0.
      SUMAW = SUMAW + Y3
 105  CONTINUE
      SLIN(I) = 10.*ALOG10(SUML)
      SAWT(I) = 10.*ALOG10(SUMA)
      SLINW(I) = 10.*ALOG10(SUMLW)
      SAWTW(I) = 10.*ALOG10(SUMAW)
      IF((I-10) .EQ. 0)  DINC = 400.0
      DST(I+1) = DST(I) + DINC
      DIS(I+1) = DST(I+1)*0.3048
 110  CONTINUE
C
C     PRINT OUT RESULTS
C
      S(1,1) = TMP
      CALL TITLE(FS,BP,WR,DF,TEMP,RELHUM,1)
      WRITE(6,45) (IFRQ(J), J = 1,8)
 45   FORMAT(5X,'DIST(FT)',4X,'LINEAR',5X,'A-WGT',8I10,/)
      WRITE(6,50) (DST(I),SLINW(I),SAWTW(I),(SW(I,J), J=1,8), I=1,IRPT)
 50   FORMAT(3X,F10.0,10F10.1)
      WRITE(6,120)
 120  FORMAT(////,11X,'OCTAVE BAND AND LINEAR TOWER SOURCE NOISE LEVELS
     1 IN DB',/)
      WRITE(6,122)
 122  FORMAT(26X,'BAND CENTER FREQUENCIES,HZ')
      WRITE(6,124) (IFRQ(J),J=1,8)
 124  FORMAT(5X,8I8,5X,'LIN',/)
      WRITE(6,126) (TSL(J),J=1,8),SLL
 126  FORMAT(1X,'SIDE',9F8.1)
      WRITE(6,128) (TSF(J), J=1,8),SLF
 128  FORMAT(2X,'FAN',9F6.1)
      WRITE(6,138)
      IT = TEMP
      IRH = RELHUM
      WRITE(6,160) IT,IRH
 160  FORMAT(//,6X,'OCTAVE BAND ATMOSPHERIC ABSORPTION COEFFICIENTS IN D
     1B PER 1000 FT',/,10X,'FOR TEMP= ',I4,' DEGREES F AND RELATIVE HUMI
     2DITY= ',I4,' PERCENT')
      WRITE(6,170)
 170  FORMAT(1H0,20X,'BAND CENTER FREQUENCIES, HZ')
      WRITE(6,180) (IFRQ(J), J =1,8)
 180  FORMAT(7X,8I7,/)
      WRITE(6,190) (ALPHA(J), J = 1,8)
 190  FORMAT(7X,8F7.3,//)
```

```
      CALL TITLE(FS,BP,WR,DF,TEMP,RELHUM,0)
      WRITE(6,45) (IFRQ(J), J=1,8)
      WRITE(6,50) (DST(I),SLIN(I),SAWT(I),(S(I,J), J=1,8), I=1,IRPT)
      WRITE(6,130)
130   FORMAT( 1H1,5X,'OCTAVE BAND GROUND ATTENUATION IN DB FOR FAN STACK
     1 RADIATED NOISE')
      WRITE(6,131)  SIGMA
131   FORMAT(17X,'FITTING PARAMETER SIGMA =',F8.1,' CGS UNITS',/)
      WRITE(6,132)
132   FORMAT(4X,'DISTANCE',11X,'BAND CENTER FREQUENIES,HZ')
      WRITE(6,134) (IFRQ(J), J=1,8)
134   FORMAT(8X,'FT',1X,8I7,/)
      WRITE(6,136)(DST(I),(GAF(I,J), J=1,8), I=1,IRPT)
136   FORMAT(1X,F10.0,8F7.1)
      WRITE(6,138)
138   FORMAT(//////)
      WRITE(6,140)
140   FORMAT(5X,'OCTAVE BAND GROUND ATTENUATION IN DB FOR NOISE FROM THE
     1 TOWER FACE')
      WRITE(6,131)  SIGMA
      WRITE(6,132)
      WRITE(6,134) (IFRW(J), J=1,8)
      WRITE(6,136) (DST(I),(GAT(I,J),J=1,8), I=1,IRPT)
      WRITE(6,138)
      STOP
      END
```

SUBROUTINE 'SOURCE'

```
      SUBROUTINE SOURCE(X1,X2,X3,X4,TSL,TSF)
C
C        CALCULATES TOWER SOURCE NOISE LEVELS FROM FITTED EQUATIONS
C        DERIVED FROM EXPERIMENTALLY MEASURED DATA
C
C          TSL(I) -- OCTAVE BAND SPL AT LOUVERED FACE
C          TSF(I) -- OCTAVE BAND SPL AT FAN STACK
C
      DIMENSION TSL(8),TSF(8)
C
      X12   = X1*X2
      X14   = X1*X4
      X11   = X1**2
      X22   = X2**2
      X33   = X3**2
      X44   = X4**2
      TSL(1) = 74.87+06.92*X1-0.25*X2+0.53*X3+1.03*X11+0.53*X22
      TSL(2) = 77.14+12.48*X1-0.10*X2-1.11*X4-0.96*X11+0.53*X22+0.84*X14
      TSL(3) = 74.65+05.85*X1+0.46*X2+0.47*X3-0.43*X4+2.80*X11+0.47*X22
     2         -0.47*X12
      TSL(4) = 72.10+2.41*X1+0.10*X2+0.09*X4+2.27*X11-0.43*X12+0.55*X14
      TSL(5) = 71.56+2.35*X1-0.06*X2+0.10*X4+1.94*X11-0.70*X12+0.82*X14
      TSL(6) = 67.54+0.79*X1+0.29*X2-0.25*X3-0.36*X4+1.07*X11-0.28*X33
     2         -0.40*X12
      TSL(7) = 63.42-0.69*X1+0.66*X2-0.85*X3-0.33*X4-0.49*X33
      TSL(8) = 60.83-1.38*X1+0.88*X2-1.33*X3-0.72*X4-0.39*X22
      TSF(1) = 87.03+8.76*X1-0.04*X4+0.69*X14
      TSF(2) = 86.36+9.05*X1-0.34*X2+0.40*X3-0.14*X4+1.41*X11+0.47*X14
      TSF(3) = 84.58+8.41*X1-0.37*X4+2.07*X11+0.32*X44+0.52*X14
      TSF(4) = 82.10+7.10*X1-0.35*X4+2.53*X11-0.29*X33+0.93*X14
      TSF(5) = 81.97+7.76*X1-0.89*X4+0.3*X44
      TSF(6) = 74.75+8.29*X1+0.01*X2+0.15*X3-0.36*X4+3.21*X11+0.40*X33
     2         +0.46*X44-0.55*X12
      TSF(7) = 68.18+4.95*X1-0.11*X3+0.16*X4+3.66*X11+0.86*X33+1.21*X44
      TSF(8) = 61.84+3.09*X1-0.62*X3+0.27*X4+4.34*X11+1.67*X33+2.41*X44
      RETURN
      END
```

SUBROUTINE 'GRND'

```
      SUBROUTINE GRND(R2,RR,DR,THETA,CZ,GND)
C
C     CALCULATES GROUND ABSORPTION ASSUMING FINITE
C     IMPEDANCE SURFACE AND FLAT TERRAIN VIA
C     THE METHOD OF CHESSEL AND RUDNICK
C
C        K         = OCTAVE BAND INDEX
C        ZRAT      = COMPLEX IMPEDANCE RATIO,Z1/Z2
C        KRAT      = COMPLEX PROPAGATION COEF. RATIO, K1/K2
C        RP        = COMPLEX REFLECTION COEFFICIENT
C        W         = COMPLEX IMAGE SOURCE NUMERICAL DISTANCE
C        FW        = COMPLEX BOUNDARY LOSS FACTOR
C        Q         = COMPLEX IMAGE SOURCE STRENGTH
C        GND(K)    = GROUND ATTENUATION, DB
C
      DIMENSION GND(8),FREQ(8)
      REAL KMAG,KAN G
      COMPLEX*16 ZRAT,W1,W2,W,RP,F1,F2,F3,F4,FW
      COMPLEX*16 TRM,SUM,Q,           KRAT,RA,RB
      DATA FREQ/63.,125.,250.,500.,1000.,2000.,4000.,8000./
C
      PI=3.1415926535897
      SIGMA=200.0
      NMAX=40
      ANG = THETA*180./PI
      DO 15 K=1,8
      FR=(FREQ(K)/SIGMA)
      WC = 2.*PI*FREQ(K)/CZ
C
C     CALCULATE IMPEDANCE RATIO, Z1/Z2
C
      AZ= 1.0 +9.08*FR**(-0.75)
      BZ=  11.9*FR**(-0.73)
      ZRAT=  CMPLX(AZ,BZ)
      ZRAT=1./ZRAT
      ZMAG =C ABS(ZRAT)
      ZANG =  ATAN2(BZ,AZ)
C
C     CALCULATE WAVE NUMBER RATIO, K1/K2
C
C     USING DELANY'S FORM FOR K
      AK=10.3*FR**(-0.59)
      BK=1.+10.8*FR**(-0.70)
      KRAT = CMPLX(AK,BK)
      KRAT = 1.0/KRAT
      KMAG =C ABS(KRAT)
      KANG =  ATAN2(BK,AK)
```

```
C
C     CALCULATE SURFACE REFLECTION COEFFICIENT,RP
C
      SA = SIN(THETA)
      CA = COS(THETA)
      RA = 1.0-(KRAT* CA)**2
      RB = ZRAT*C SQRT(RA)
      RP = (SA-RB)/(SA+RB)
      RPR= REAL(RP)
      RPI= AIMAG(RP)
C
C     CALCULATE IMAGE SOURCE NUMERICAL DISTANCE
C
      W1 = (ZRAT**2)*(1.0-(KRAT* CA)**2)
      W2 = CMPLX(0.,1.)*WC*R2*2.0/((1.0-RP)* CA)**2
      W=W1*W2
      WMAG=CABS(W)
      IF((WMAG-10.).GT.0.) GO TO 7
      F1 = CMPLX(0.,1.)*CEXP(-W)
      F2 = CSQRT(PI*W)
      F3 = F1*F2
C
C     COMPUTE SERIES TERM FOR F(W)
C           IF WMAG < 10
C
      ND=1
      TRM = CMPLX(1.,0.)
      SUM= CMPLX(0.0,0.0)
      DO 5 I=1,NMAX
      EM = 2.*FLOAT(I)-1.
      EN = FLOAT(I-1)
      EO = EM-2.
      IF(EO .LE. 0.)  EO = 1.
      IF(I-1 .EQ. 0)  EN=1.0
      TRM = TRM*W*EO/(EN*EM)
      SUM=SUM+TRM
      CHK=C ABS(TRM)/C ABS(SUM)
      IF((CHK-0.001).LT.0.) GO TO 6
    5 CONTINUE
    6 F4=-2.*C EXP(-W)*SUM
      FW = 1. + F3 + F4
      GO TO 10
C
C     COMPUTE SERIES TERM FOR F(W)
C           IF WMAG > 10
C
    7 N2=1
      N1=1
      TRM = CMPLX(1.,0.)
      SUM= CMPLX(0.0,0.0)
      DO 8 I=1,NMAX
      EM = 2.*FLOAT(I)-1.
      TRM = TRM•EM•0.5/W
      SUM=SUM+TRM
      CHK=C ABS(TRM)/C ABS(SUN)
      IF((CHK-0.001) .LT. 0.)  GO TO 9
 8    CONTINUE
 9    FW=-SUN
C
C     COMPUTE SOURCE STRENGTH & ATTENUATION
C
 10   Q=RP+FW•(1.-RP)
 12   QMAG=C ABS(Q)
      QR= REAL(Q)
      QI=AIMAG(Q)
      BETA= ATAN2(QI.QR)
      ALAM=CZ/FREQ(K)
      AMEW = 1.414•PI•DR/ALAM
      ETA = 2.•1.0606•PI•DR/ALAM
      A1 = QMAG/RR
      A2 = 1.+A1••2
      A3 = AMEW
      A4 = SIN(A3)
      A5 = COS(ETA•DR /ALAM + BETA)
      A6 = A2+2.•A1•A4•A5/A3
      ATN = 10.•ALOG10(A6)
      GND(K)=ATN
      ZR= REAL(ZRAT)
      ZI=AIMAG(ZRAT)
      FMAG=CABS(FW)
      FREAL= REAL(FW)
 15   CONTINUE
 31   RETURN
      END
```

SUBROUTINE 'ABSORB'

```
   1.          SUBROUTINE ABSORB(TEMP,RELHUM,ALPHA)
   2.     C
   3.     C          CALCULATES OCTAVE BAND ATMOSPHERIC ABSORPTION COEFFICIENTS
   4.     C          FOR GIVEN  TEMP(DEG F) AND RELATIVE HUMIDITY(%)--UNITS OF
   5.     C          ABSORPTION COEFFICIENT ARE DB/1000 FT
   6.     C
   7.          DIMENSION IFRQ(8),FREQ(8),TABLE(59)
   8.          DIMENSION HMOLMX(8),AMOLMX(8),HUMRAT(8),ALPRAT(8)
   9.          DIMENSION ALPMOL(8),ALPCLA(8),ALPHA(8)
  10.          DATA TABLE/29.0,0.0,0.25,0.315,0.5,0.7,0.6,0.84,0.7,0.93,
  11.         1.8,.975,.9,.996,1.,1.,1.1,.97,1.2,.9,1.3,.84,1.5,.75,1.7,.67,2.,
  12.         2.57,2.3,.495,2.5,.45,2.8,.4,3.,.37,3.3,.33,3.6,.3,4.15,.26,4.45,
  13.         3.245,4.8,.23,5.25,.22,5.7,.21,6.05,.205,6.5,.2,7.,.2,10.,.2/
*DIAGNOSTIC*  A LIST IN THE ABOVE STATEMENT IS TOO LONG.
  14.          DATA IFRQ/63,125,250,500,1000,2000,4000,8000/
  15.          DATA FREQ/63.,125.,250.,500.,1000.,2000.,4000.,8000./
  16.          IRH  = RELHUM
  17.          IT   = TEMP
  18.          B    = 1.97274664-0.02288074*TEMP+0.00009569*TEMP**2
  19.         2       -0.0000003*TEMP**3
  20.          ABSHUM = 10.**(ALOG10(RELHUM-B))
  21.          DO 150  J = 1,8
  22.          AMOLMX(J)= 10.**(ALOG10(FREQ(J))+0.00468333*TEMP-2.4215)
  23.          HMOLMX(J) = (FREQ(J)/1010.)**0.5
  24.          HUMRAT(J) = ABSHUM/HMOLMX(J)
  25.          L     = 3
  26.          IF(HUMRAT(J) .LE. TABLE(2)) GO TO 130
  27.          DO 90  I = 4,58,2
  28.          L     = I+1
  29.     80   IF(TABLE(I)-HUMRAT(J))  90,130,110
  30.     90   CONTINUE
  31.          GO TO 130
  32.    110   I     = I-2
  33.          IF(I .GE. 4) GO TO 120
  34.          I     = I+2
  35.    120   XA1   = HUMRAT(J) - TABLE(I)
  36.          XA0   = HUMRAT(J) - TABLE(I-2)
  37.          XA2   = HUMRAT(J) - TABLE(I+2)
  38.          X01   = TABLE(I-2) - TABLE(I)
  39.          X02   = TABLE(I-2) - TABLE(I+2)
  40.          X12   = TABLE(I) - TABLE(I+2)
  41.          ALPRAT(J) = TABLE(I-1)*(XA1/X01)*(XA2/X02)-
  42.         1            TABLE(I+1)*(XA0/X01)*(XA2/X12)+
  43.         2            TABLE(I+3)*(XA0/X02)*(XA1/X12)
  44.          GO TO  140
  45.    130   ALPRAT(J) = TABLE(L)
  46.    140   CONTINUE
  47.          ALPMOL(J) = ALPRAT(J)*ALPMOL(J)
```

```
      ALPCLA(J) = 10.**(2.05*ALOG10(FREQ(J)/1000.)+(0.000633*TEMP)
     1            -1.45325)
      ALPHA(J) = ALPCLA(J) + ALPMOL(J)
  150 CONTINUE
      RETURN
      END
```

SUBROUTINE 'TITLE'

```
      SUBROUTINE TITLE(FS,BP,WR,DF,TEMP,RELHUM,L)
      WRITE(6,1)
    1 FORMAT(1H1)
      WRITE(6,2)
    2 FORMAT(29X,'P R E D I C T E D   C O O L I N G  T O W E R  N O I S
     1E  L E V E L S')
      IF(L .EQ. 0)  GO TO 4
      WRITE(6,3)
    3 FORMAT(/,37X,'I N C L U D I N G   G R O U N D  A B S O R P T I O N
     1')
    4 WRITE(6,5) FS,BP,WR,DF
    5 FORMAT(//,5X,'TOWER OPERATING AND TEST CONDITIONS-- ',/,20X,'FAN S
     1PEED(PERCENT)  =',F8.1,4X,'BLADE PITCH(DEG) =',F9.1,/,20X,'TOT. WA
     2TER FLOW(GPM)=',F8.1,4X,'DRY FLOW(PERCENT)=',F9.1)
      WRITE(6,6) TEMP,RELHUM
    6 FORMAT(20X,'TEMPERATURE(DEG F)  =',F8.1,4X,'REL HUM(PERCENT) =',
     2F9.1,//)
      WRITE(6,7)
    7 FORMAT(43X,'OCTAVE BAND CENTER FREQUENCIES, HZ')
      RETURN
      END
```

APPENDIX H

BASIC PLUME AND COOLING TOWER DATA

As discussed in the body of the report, this appendix contains a tabulation of the data as received from the Fluid Systems Laboratory (FSL). Table H-1 gives a sample of the data as received, with a legend giving the meteorological, cooling tower, or plume parameter represented in each position.

It should be noted that the data recorded by the Tethersonde is in metric (SI) units, while the data required as input by Rubin's program are to be in English units. The appropriate conversions were performed at the Fluid Systems Laboratory, as part of the data preparation.

TABLE H-1

SAMPLE OF RAW DATA FILE FOR PLUME TESTS

```
                                                                          RUN IDENTIFIER
 : RUNID 511021   MAR 23, 1978
  2.945   2.945   2.945   2.947   2.949   2.949   2.947   2.946   2.945
  2.943   2.941   2.938   2.937   2.936   2.935   2.936   2.937   2.938    VISIOMETER OUTPUT-
  2.934   2.934   2.932   2.931   2.931   2.932   2.935   2.938   2.941     VOLTS-AT LEAST 50
  2.945   2.948   2.947   2.945   2.948   2.950   2.950   2.949   2.950     READINGS
  2.951   2.951   2.951   2.949   2.946   2.945   2.941   2.937   2.932
  2.930   2.928   2.923   2.920   2.918   2.917   2.914
200                                                                       PSEUDO-CHANNEL NUMBER-
109.240   9.870  39.000   3.190  84.870   7.950  35.610    .350 317.400    BALLOON 30' AGL
109.450   9.950  39.310   3.190  84.660   6.660  33.010    .590 341.300
109.670   9.970  39.300   3.240  84.820   6.300  27.210    .590 341.300   4 SCANS TETHERSONDE
109.880  10.140  39.700   3.180  84.980   7.596  37.840    .300 345.200     DATA
201                                                                       PSEUDO-CHANNEL NUMBER
111.170  10.210  39.700   3.230  84.910   8.830  41.300   1.120  19.800    BALLOON 75' AGL
111.390  10.110  40.330   3.220  84.850  10.170  42.380   1.280  25.600
111.600   9.990  39.710   3.230  84.790  10.000  36.200   1.320  15.800   4 SCANS TETHERSONDE
111.820  10.030  39.500   3.160  84.710   9.330  33.700    .970 359.400     DATA
202                                                                       PSEUDO-CHANNEL NUMBER
113.330  10.020  39.940   3.140  84.730  11.750  44.820    .880 331.700    BALLOON 125' AGL
113.540  10.150  39.820   3.190  84.850  11.660  46.670   1.080 342.600   (CH 203 IS 175' AGL)
113.760   9.900  40.290   3.230  84.840  11.010  44.560    .720 334.700
113.970  10.160  40.340   3.190  84.540  11.000  43.420    .700 355.700
204                                                                       PSEUDO-CHANNEL NUMBER
114.830  10.370  41.290   3.480  84.720  13.270  58.550    .020 358.200    TOP OF PLUME
115.050  10.460  41.600   3.630  84.810  12.710  54.510   1.110  28.500
115.260  10.480  41.670   3.400  84.820  14.060  56.110   1.220 326.900   4 SCANS TETHERSONDE
115.480  10.420  41.350   3.550  84.790  12.510  60.440   1.250  40.000
 : RUNID 511022   MAR 23, 1978                                              DATA
  1.953   1.953   1.954   1.955   1.957   1.961   1.966   1.971   1.975
  1.977   1.976   1.974   1.972   1.971   1.972   1.971   1.968   1.966
  1.965   1.965   1.965   1.966   1.959   1.952   1.949   1.947   1.945
  1.945   1.945   1.943   1.940   1.937   1.936   1.937   1.938   1.939
  [illegible] [illegible] [illegible] 1.908 1.907 [illegible] [illegible] 1.908 1.908
  [illegible] 1.457 [illegible] [illegible] [illegible] [illegible] [illegible]
  1.470   1.471   1.471   [illegible] [illegible] 1.476 1.481 [illegible]
  1.477   1.480   1.484   1.489   1.493   1.492   1.491   1.491   1.493
  1.496   1.497   1.498   1.498   1.494   1.488   1.484   1.483   1.484
  1.483   1.482   1.481   1.476   1.471   1.468   1.461   1.452   1.448
  1.448   1.449   1.448   1.447   1.447   1.448   1.444
200
141.140  12.660  50.640   4.380  84.790  10.680  38.780    .680 284.300
141.360  12.990  51.450   4.600  84.970  11.190  44.530   1.000 280.400
141.570  12.850  51.420   4.550  84.920  11.840  43.290   1.300 303.100
```

(Continued)

Table H-1 (cont'd)

```
141.790  12.880  51.520   4.440  84.840   9.710  38.240   1.100 282.000
201
142.870  13.490  53.690   5.230  85.010  10.890  43.250    .120 150.500
143.080  14.450  56.940   5.660  84.860  11.610  44.760    .900 129.100
143.300  14.100  56.320   5.580  84.870  11.530  50.590   1.310 116.400
143.520  14.330  57.100   5.750  84.890  11.590  45.810   1.320 109.500
PLUME DATAPLUME DATAPLUME DATAPLUME DAT:PLUME DATAPLUME DATAPLUME DATA
 511021
     36.4      63.5      71.0      11.8     100.01.2273E+046.0658E+07
     50.2      82.9       3.8      75.0 2.939E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511022
     36.4      63.5      71.3      12.3     100.01.2769E+045.9784E+07
     53.3      81.4       2.5      75.0 1.942E+00

 : RUNID 511061   MAR 28, 1978
  2.147   2.148   2.152   2.159   2.160   2.157   2.157   2.157   2.159
  2.161   2.163   2.157   2.151   2.147   2.148   2.152   2.157   2.163
  2.165   2.165   2.155   2.151   2.147   2.147   2.145   2.142   2.137
  2.127   2.121   2.122   2.125   2.129   2.133   2.131   2.132   2.136
  2.146   2.151   2.156   2.158   2.159   2.161   2.163   2.162   2.150
  2.144   2.139   2.135   2.134   2.137   2.137   2.132
 200
  48.680   -.230 100.240   -.090  84.360       0  28.460   1.850 287.400
  48.900   -.090 100.320   -.050  84.370       0  26.020   1.770 287.300
  49.110   -.230  99.980   -.090  84.250       0  28.480   2.010 288.700
  49.330   -.040 100.190   -.050  84.360       0  29.320   1.750 281.300
                   ET                BC             EP
 201
  50.410    .770   2.340    .110  84.490  -9.570  33.090   1.970 279.800
-)
```

DATA FORMATTED
FOR INPUT TO
RUBIN'S PROGRAM

WIND VELOCITY (M/SEC)

TEMPERATURE
(DEGREES C)

WIND DIRECTION (MAGNETIC)

TIME-
SECONDS
AFTER
SYNCHRONIZATION

WET BULB
DEPRESSION
(DEGREES C)

PRESSURE DIFFERENCE
FROM REFERENCE (MB)

ET, EP - EXPANDED TEMPERATURE, PRESSURE
(NOT USED)

BC - BATTERY CHARGE - PERCENT OF FULL CHARGE

(Continued)

Table H-1 (cont'd)

```
  : RUNID 511021   MAR 23, 1978
   2.945   2.945   2.945   2.947   2.949   2.949   2.947   2.946   2.945
   2.943   2.941   2.938   2.937   2.936   2.935   2.936   2.937   2.938
   2.934   2.934   2.932   2.931   2.931   2.932   2.935   2.938   2.941
   2.945   2.948   2.947   2.945   2.948   2.950   2.950   2.949   2.950
   2.951   2.951   2.951   2.949   2.946   2.945   2.941   2.937   2.932
   2.930   2.928   2.923   2.920   2.918   2.917   2.914
 200
 109.240   9.870  39.000   3.190  84.870   7.950  35.610    .350 317.400
 109.450   9.950  39.310   3.190  84.660   6.660  33.010    .590 341.300
 109.670   9.970  39.300   3.240  84.820   6.300  27.210    .590 341.800
 109.880  10.140  39.700   3.180  84.980   7.590  37.840    .300 345.200
 201
 111.170  10.210  39.700   3.230  84.910   8.830  41.300   1.120  19.800
 111.390  10.110  40.330   3.220  84.850  10.170  42.380   1.280  25.600
 111.600   9.990  39.710   3.230  84.790  10.000  36.200   1.320  15.800
 111.820  10.030  39.500   3.160  84.710   9.330  33.700    .970 359.400
 202
 113.330  10.020  39.940   3.140  84.730  11.750  44.820    .880 331.700
 113.540  10.150  39.820   3.190  84.850  11.660  46.670   1.080 342.600
 113.760   9.900  40.290   3.230  84.840  11.010  44.560    .720 334.700
 113.970  10.160  40.340   3.190  84.540  11.000  43.420    .700 355.700
 204
 114.830  10.370  41.290   3.480  84.720  13.270  58.550    .020 358.200
 115.050  10.460  41.600   3.630  84.810  12.710  54.510   1.110  28.500
 115.260  10.480  41.670   3.400  84.820  14.060  56.110   1.220 326.900
 115.480  10.420  41.350   3.550  84.790  12.510  60.440   1.250  40.000
  : RUNID 511022   MAR 23, 1978
   1.953   1.953   1.954   1.955   1.957   1.961   1.966   1.971   1.975
   1.977   1.976   1.974   1.972   1.971   1.972   1.971   1.968   1.966
   1.965   1.965   1.965   1.966   1.959   1.952   1.949   1.947   1.945
   1.945   1.945   1.943   1.940   1.937   1.936   1.937   1.938   1.939
   1.930   1.918   1.910   1.908   1.907   1.907   1.907   1.908   1.908
   1.909   1.911   1.909   1.906   1.904   1.902   1.900
 200
 126.460  11.590  46.610   3.880  84.640  10.070  37.580    .850 341.900
 126.680  11.900  47.380   4.070  84.780   9.900  39.420    .560  22.200
 126.890  11.930  46.980   4.090  84.810   9.690  44.510    .250  18.100
 127.110  12.020  47.210   4.070  84.900  11.110  43.260    .330  13.100
 201
 128.400  11.780  46.540   3.830  84.600  11.240  47.790    .880 356.900
 128.620  11.750  46.740   3.980  84.810  13.900  48.400    .700  16.000
 128.830  11.830  47.040   3.930  84.690  11.420  44.930    .800 339.800
 129.050  11.870  46.610   3.960  84.800  10.950  53.090    .610 334.000
 204
 130.130  12.910  50.820   4.740  84.660  13.940  59.260   1.600  48.600
 130.350  12.490  49.800   4.530  84.680  14.220  62.920    .880  45.500
 130.560  12.950  51.410   4.940  84.750  15.610  57.210    .360  60.400
 130.780  13.330  52.870   5.000  84.820  14.610  55.160    .490  40.600
  : RUNID 511023   MAR 23, 1978
   1.458   1.457   1.456   1.455   1.456   1.459   1.462   1.465   1.467
   1.470   1.471   1.471   1.472   1.473   1.476   1.481   1.479   1.476
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(Continued)

Table H-1 (cont'd)

```
   1.477   1.480   1.484   1.489   1.493   1.492   1.491   1.491   1.493
   1.496   1.497   1.498   1.498   1.494   1.488   1.484   1.483   1.484
   1.483   1.482   1.481   1.476   1.471   1.468   1.461   1.452   1.448
   1.448   1.449   1.448   1.447   1.447   1.448   1.444
 200
 141.140  12.660  50.640   4.380  84.790  10.680  38.780    .680 284.300
 141.360  12.990  51.450   4.600  84.970  11.190  44.530   1.000 280.400
 141.570  12.850  51.420   4.550  84.920  11.840  43.290   1.300 303.100
 141.790  12.880  51.520   4.440  84.840   9.710  38.240   1.100 282.000
 201
 142.870  13.490  53.690   5.230  85.010  10.890  43.250    .120 150.500
 143.080  14.450  56.940   5.660  84.860  11.610  44.760    .900 129.100
 143.300  14.100  56.320   5.580  84.870  11.530  50.590   1.310 116.400
 143.520  14.330  57.100   5.750  84.890  11.590  45.810   1.320 109.500
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511021
      36.4       63.5       71.0       11.8      100.01.2273E+046.0658E+07
      50.2       82.9        3.8       75.0 2.939E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511022
      36.4       63.5       71.3       12.3      100.01.2769E+045.9784E+07
      53.3       81.4        2.5       75.0 1.942E+00

  : RUNID 511061   MAR 28, 1978
   2.147   2.148   2.152   2.159   2.160   2.157   2.157   2.157   2.159
   2.161   2.163   2.157   2.151   2.147   2.148   2.152   2.157   2.163
   2.165   2.165   2.155   2.151   2.147   2.147   2.145   2.142   2.137
   2.127   2.121   2.122   2.125   2.129   2.133   2.131   2.132   2.136
   2.146   2.151   2.156   2.158   2.159   2.161   2.163   2.162   2.150
   2.144   2.139   2.135   2.134   2.137   2.137   2.132
  200
  48.690   -,230 100.240   -.090  84.360       0  28.460   1.850 287.400
  48.900   -.090 100.320   -.050  84.370       0  26.020   1.770 287.300
  49.110   -,230  99.980   -.090  84.250       0  28.480   2.010 288.700
  49.330   -.040 100.190   -.050  84.360       0  29.320   1.750 281.300
  201
  50.410    .770   2.340    .110  84.490  -9.570  33.090   1.970 279.800
  50.630    .740   2.370    .160  84.420       0  29.380   2.100 281.400
  50.840    .840   3.070    .180  84.380  -9.030  25.680   1.960 278.100
  51.060    .950   2.890    .150  84.270       0  21.610   2.140 279.200
  202
  52.140   2.050   7.870    .400  84.200  -7.590  -3.580   2.170 260.200
  52.360   1.920   7.900    .390  84.140  -7.370  -3.900   2.240 260.400
  52.570   2.130   7.950    .300  84.150  -7.530   3.740   2.080 260.700
  52.790   2.200   8.110    .360  84.340  -6.090  -7.420   2.220 263.900
  203
  54.300   3.480  12.660    .430  84.280  -4.640   2.440   1.940 289.700
  54.520   3.310  12.700    .390  84.290  -3.090       0   1.930 284.100
  54.730   3.100  12.370    .340  84.010  -3.930       0   1.900 286.700
  54.950   3.510  13.440    .460  84.210  -4.100       0   1.940 294.000
  204
  57.330   6.400  25.330    .630  83.960   3.480  14.200   4.660 320.800
  57.540   6.410  25.230    .470  83.950   3.260  18.580   4.520 317.800
  57.760   6.160  24.450    .320  83.900   3.800  18.700   4.590 319.600
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(Continued)

Table H-1 (cont'd)

```
 57.980   6.140  24.290    .210  83.900   4.040  16.410   4.700 314.900
 : RUNID 511062   MAR 28, 1978
  2.941   2.941   2.942   2.946   2.951   2.955   2.956   2.954   2.956
  2.959   2.964   2.968   2.972   2.977   2.980   2.976   2.971   2.975
  2.982   2.978   2.971   2.965   2.962   2.962   2.962   2.965   2.966
  2.968   2.972   2.976   2.981   2.993   3.006   3.010   3.015   3.018
  3.022   3.026   3.025   3.021   3.021   3.027   3.031   3.031   3.032
  3.037   3.050   3.063   3.071   3.079   3.086   3.091
200
 84.110   2.180   8.370    .510  83.280       0  34.060    .300  17.000
 84.330   2.450   9.080    .690  83.340  -9.670  24.620    .350  17.200
 84.540   2.260   8.980    .740  83.450       0  28.350    .360  17.700
 84.760   2.410   8.970    .740  83.310       0  27.460    .380  16.100
201
 86.050   3.240  12.600   1.190  83.330       0  30.560    .070   7.900
 86.270   3.390  12.970   1.150  83.270       0  24.890    .570   5.500
 86.490   3.320  12.300    .970  83.210  -8.900  25.090    .540  11.700
 86.700   3.380  12.790    .980  83.290  -7.620  29.970    .510 357.200
202
 87.780   3.390  13.660   1.140  83.150  -6.280       0    .980 340.600
 88.000   3.420  14.000   1.190  83.290  -6.880       0    .990 326.800
 88.210   3.590  13.890   1.020  83.180  -7.410       0   1.180 343.100
 88.430   3.460  13.370    .970  83.160  -6.280       0    .790   -.100
203
 89.940   4.450  17.170   1.650  83.190  -2.550       0   1.590 327.100
 90.160   4.510  17.410   1.560  83.180  -3.320       0   1.630 327.000
 90.370   4.580  18.210   1.690  82.960  -1.700  -7.830   1.660 314.000
 90.590   4.590  18.090   1.770  83.130  -3.040  -6.920   1.440 316.200
204
 92.320   6.380  24.940   2.540  83.060   3.730  16.080   4.340 305.300
 92.530   6.350  24.860   2.580  82.920   4.520  18.420   4.390 306.300
 92.750   6.340  25.260   2.660  82.930   4.530  16.520   4.440 310.200
 92.970   6.520  25.230   2.590  83.010   4.110  18.500   4.260 308.000
 : RUNID 511063   MAR 28, 1978
  3.246   3.246   3.246   3.244   3.241   3.236   3.232   3.227   3.220
  3.216   3.213   3.214   3.215   3.218   3.223   3.226   3.229   3.230
  3.234   3.234   3.233   3.231   3.231   3.231   3.233   3.231   3.231
  3.228   3.223   3.219   3.218   3.217   3.218   3.221   3.225   3.232
  3.235   3.237   3.236   3.234   3.231   3.228   3.223   3.219   3.212
  3.203   3.202   3.204   3.206   3.214   3.219   3.222
200
104.620   3.420  12.890    .870  82.620  -5.550       0   1.210 283.400
104.840   3.370  13.040    .800  82.430  -3.610       0   1.120 287.200
105.050   3.360  12.980    .680  82.490  -4.710       0   1.360 296.300
105.270   3.550  13.510    .840  82.640  -5.450       0   1.410 286.200
201
106.780   4.160  16.190   1.250  82.690  -1.910  -6.590    .750 305.800
107.000   4.130  16.420   1.210  82.410  -2.710 -10.360    .810 305.600
107.210   4.390  17.090   1.370  82.570  -1.620 -10.650    .480 335.600
107.430   4.380  17.450   1.340  82.390  -3.870  -9.420    .440 294.100
202
108.720   6.230  24.800   2.780  82.590    .740   5.870    .010 151.700
108.940   5.550  21.270   1.970  82.480   1.150   5.130       0 165.300
109.150   5.840  23.770   2.500  82.480  -1.160  -4.500   1.320 114.300
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(Continued)

Table H-1 (cont'd)

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 109.370   6.190  24.130   2.250  82.540  -1.550  -3.700    .640 138.900
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511061
     36.4       63.5       64.5       19.0      100.01.9826E+041.8188E+08
     33.5       98.5        6.7       75.0 2.147E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511062
     36.4       63.5       69.5       19.7      100.02.0521E+042.1804E+08
     38.0       90.9        1.4       75.0 2.993E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511063
     36.4       63.5       70.4       19.3      100.02.0100E+042.0450E+08
     38.2       93.3        4.2       30.0 3.226E+00

   : RUNID 511071   MAR 28, 1978
    .046    .045    .044    .042    .041    .040    .038    .037    .037
    .036    .035    .035    .035    .034    .032    .030    .029    .028
    .027    .026    .025    .024    .023    .022    .022    .024    .028
    .035    .039    .040    .039    .038    .040    .041    .041    .040
    .039    .036    .033    .031    .029    .030    .031    .036    .039
    .039    .037    .034    .032    .029    .027    .025
  200
   11.950   8.840  35.260   2.850  92.620   7.260  29.150   1.840 257.800
   12.160   8.980  35.650   2.870  92.680   6.660  28.800   1.170 272.200
   12.380   9.180  36.270   2.950  92.680   6.290  33.790    .700 298.900
   12.600   9.020  36.170   2.880  92.440   7.100  29.660   1.610 272.700
  201
   14.320   8.850  35.210   2.870  92.040   8.710  33.150   2.590 284.200
   14.540   8.810  34.910   2.740  92.190   8.230  34.480   2.640 275.800
   14.750   8.740  34.680   2.780  91.990   7.870  33.600   2.350 279.900
   14.970   8.730  34.930   2.870  91.960   8.260  33.410   2.440 271.800
  204
   16.260   8.730  34.470   2.780  91.780   9.360  37.560   3.090 265.000
   16.480   8.670  34.410   2.800  91.660   8.990  36.600   2.760 282.100
   16.690   8.710  34.690   2.780  91.700   9.020  38.460   3.850 277.800
   16.910   8.770  34.870   2.870  91.610   9.250  37.740   3.050 297.200
   : RUNID 511072   MAR 28, 1978
   -.072   -.072   -.072   -.072   -.072   -.072   -.072   -.072   -.072
   -.072   -.071   -.071   -.071   -.071   -.070   -.070   -.069   -.070
   -.070   -.070   -.069   -.069   -.069   -.069   -.069   -.069   -.069
   -.069   -.070   -.069   -.069   -.069   -.070   -.069   -.069   -.069
   -.069   -.069   -.069   -.069   -.069   -.069   -.069   -.069   -.069
   -.069   -.069   -.069   -.070   -.070   -.070   -.070
  200
   28.540  10.760  41.620   3.370  89.450   3.160  16.690   1.270  15.100
   28.750  10.120  40.320   3.110  89.210   4.640  16.730   3.020  20.000
   28.970  10.150  40.410   3.070  89.310   3.040  12.980    .080   9.400
   29.190   9.920  39.370   3.370  89.170   4.630  17.760       0 351.900
  201
   30.910   9.990  39.420       0  88.870   6.830  28.980   2.970 288.300
   31.120  10.030  39.470       0  88.790   5.050  26.050   3.750 294.800
   31.340  10.040  39.390       0  88.680   5.110  29.620   4.090 316.400
   31.550   9.880  39.390  -3.130  88.690   5.250  24.200   3.550 313.500
  204
```

(Continued)

Table H-1 (cont'd)

```
   33.490   9.960  39.540       0  88.320   6.580  30.800   1.250 320.600
   33.700   9.860  39.750       0  88.300   7.650  36.800   2.170 341.300
   33.920   9.980  39.770       0  88.230   8.360  33.340   2.150 329.800
   34.140  10.040  39.920       0  88.320   7.500  33.020   2.410 338.900
   : RUNID 511073   MAR 28, 1978
    -.078   -.078   -.079   -.078   -.079   -.079   -.079   -.079   -.079
    -.079   -.080   -.080   -.080   -.080   -.080   -.080   -.080   -.081
    -.080   -.080   -.081   -.080   -.080   -.080   -.080   -.080   -.080
    -.081   -.080   -.081   -.080   -.081   -.081   -.081   -.081   -.081
    -.080   -.080   -.081   -.081   -.081   -.081   -.081   -.081   -.081
    -.082   -.082   -.082   -.082   -.082   -.083   -.082
  200
   52.000  10.850  43.060   3.480  85.310   7.080  26.100   2.350  19.300
   52.210  10.770  43.000   3.530  85.380   6.340  27.980   2.150   1.000
   52.430  10.690  42.890   3.620  85.300   6.520  27.660   2.100  11.800
   52.650  10.720  43.110   3.630  85.180   6.410  28.880   1.510  27.900
 PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
  511071
       36.4       63.5       73.7        9.5       98.59.9018E+037.7810E+07
       47.8       83.6        8.2       75.0 3.394E-02
 PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
  511072
       36.4       63.5       71.8        9.4       94.59.7856E+036.2056E+07
       50.0      100.0       11.8       75.0-6.994E-02
 PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
  511073
       36.4       63.5       72.0       11.0       89.01.1414E+045.8500E+07
       51.4       61.9        6.7       20.0-8.035E-02

   : RUNID 511081   APR  4, 1978
     .412    .415    .417    .420    .419    .414    .409    .404    .402
     .399    .396    .390    .390    .400    .405    .403    .400    .397
     .393    .390    .385    .380    .377    .378    .377    .375    .374
     .372    .370    .376    .382    .384    .382    .378    .374    .372
     .369    .366    .361    .357    .357    .363    .375    .394    .407
     .413    .414    .413    .409    .408    .405    .404
  200
     .910   9.230  36.040    .600  60.330   9.860  38.200   1.180 278.900
    1.130   9.130  35.850    .640  60.040  10.180  39.860    .950 281.600
    1.340   9.270  36.150    .520  60.040   9.290  40.510    .970 287.300
    1.560   9.200  36.440    .530  59.940   9.490  37.630   1.040 273.300
  201
    2.200   9.350  36.670    .520  60.150  11.310  42.570    .860 281.300
    2.410   9.520  37.710    .690  59.920  10.310  39.730    .710 308.500
    2.630   9.560  37.640    .520  59.630   9.440  40.620    .700 347.800
    2.840   9.450  37.140    .430  59.380  10.750  44.090    .760 351.500
  202
    3.700   9.730  38.850    .800  60.740  11.930  50.090   1.450 347.700
    3.920   9.990  39.150    .610  60.390  11.490  49.820   1.310 342.000
    4.130   9.720  38.440    .620  60.390  12.130  46.270   1.340 347.600
    4.350   9.720  38.260    .670  60.390  12.260  50.880   1.280 352.800
  203
    5.420   9.960  39.210    .710  61.130  15.160  57.650   2.040    .300
    5.640   9.940  39.420    .660  60.060  13.640  55.270    .580  39.600
```

(Continued)

Table H-1 (cont'd)

```
   5.850  10.250  40.460     .590  60.910  13.300  58.100   1.710  14.800
   6.070  10.090  39.670     .460  59.840  12.900  57.600    .840  39.600
 204
   7.570  13.340  52.930     .640  59.250  15.720  65.490   2.530 146.900
   7.790  13.120  52.350     .300  65.260  15.660  62.900   -.070  32.300
   8.000  12.240  48.430    -.240  64.160  15.190  64.530   4.820 100.500
   8.220  13.450  53.020    -.020  68.740  15.740  62.110    .280 147.300
  : RUNID 511082   APR  4, 1978
    .172     .171     .171     .171     .170     .168     .167     .164     .162
    .160     .157     .159     .162     .170     .175     .177     .178     .177
    .176     .174     .171     .168     .166     .166     .170     .171     .171
    .170     .168     .166     .165     .162     .161     .159     .157     .156
    .156     .155     .155     .154     .154     .157     .159     .158     .156
    .155     .154     .152     .154     .155     .155     .155
 200
  22.620   9.790  38.510     .650  60.000   4.840  19.230   1.500 312.500
  22.830   9.710  38.370     .620  59.790   4.580  19.470   1.130 301.600
  23.050   9.730  38.460     .710  59.840   4.450  21.610   1.330 303.100
  23.260   9.740  38.550     .790  59.420   5.090  18.750   1.160 306.900
 201
  24.120  10.200  40.030     .680  59.860   6.640  25.950   1.510 298.800
  24.340   9.970  39.490     .590  59.700   6.240  26.930   1.270 301.200
  24.550   9.950  39.350     .700  59.690   6.870  25.910   1.310 300.600
  24.770  10.010  39.610     .740  59.600   6.900  26.200   1.300 299.500
 202
  25.630  10.250  40.450     .630  59.880   8.150  31.990   1.270 323.800
  25.840  10.230  40.600     .560  59.670   8.430  33.690   1.390 322.700
  26.060  10.280  40.620     .500  59.560   8.160  33.540   1.290 325.300
  26.270  10.280  40.560     .470  59.550   8.460  34.600   1.220 315.400
 203
  27.130  10.190  40.570     .300  58.980  10.170  42.390    .910 352.700
  27.350  10.220  40.450     .130  58.910  10.650  44.290    .920 357.000
  27.560  10.210  40.450     .210  58.910  11.450  43.280    .900 349.400
  27.780  10.250  40.600     .200  58.540  10.820  44.480    .680 354.500
 204
  28.850  10.690  42.430     .210  57.880  15.290  65.050    .120 167.400
  29.070  10.870  43.280     .250  57.870  14.460  60.340    .420 290.700
  29.280  11.100  43.720        0  58.810  15.520  59.260    .460 318.200
  29.500  10.950  43.150    -.130  57.910  15.040  63.060    .700 322.500
  : RUNID 511083·  APR  4, 1978
    .154     .153     .153     .151     .149     .148     .150     .155     .158
    .159     .160     .161     .161     .161     .162     .160     .159     .158
    .156     .155     .153     .151     .151     .151     .150     .149     .148
    .146     .145     .145     .146     .146     .148     .151     .151     .153
    .153     .154     .158     .164     .167     .168     .171     .172     .171
    .170     .169     .169     .169     .168     .167     .165
 200
  11.380  10.600  41.850     .240  57.990   5.310  22.950    .770 321.300
  11.600  10.510  41.440     .150  58.170   5.460  19.490    .490 330.700
  11.810  10.560  41.540     .150  58.390   5.470  23.270    .670 315.500
  12.030  10.620  41.930     .190  58.790   5.200  23.240    .860 313.100
 201
  12.890  10.470  41.380     .340  58.320   6.970  28.720    .950 327.900
  13.100  10.490  41.470     .280  58.920   6.630  28.700   1.000 326.900
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(Continued)

Table H-1 (cont'd)

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  13.320  10.370  41.060    .240  59.300   6.600  29.170   1.380 324.000
  13.530  10.380  41.090    .320  58.910   6.810  29.630   1.060 319.400
 202
  14.390  10.410  41.340    .290  59.260   8.630  37.260   1.170 349.800
  14.610  10.440  41.590    .320  58.930   9.390  35.430   1.070 348.400
  14.820  10.410  41.180    .230  59.030   8.990  35.560   1.020 348.000
  15.040  10.410  41.250    .220  58.340   8.640  34.990    .780 344.200
 203
  15.900  10.690  42.290    .160  59.110  11.160  47.180   1.390 315.900
  16.110  10.630  42.010    .050  58.400  11.320  45.610    .520 303.200
  16.330  10.590  41.940    .040  58.110  11.100  47.510    .700 325.900
  16.540  10.520  41.720       0  58.310  11.470  45.870    .530 309.200
 204
  17.620  10.660  42.210    .010  57.860  14.750  59.710    .500 128.700
  17.830  10.680  42.050   -.060  57.920  14.190  57.990   1.260 280.900
  18.050  10.880  42.680       0  58.410  14.160  59.850   1.770 238.100
  18.260  10.820  42.730    .060  60.000  14.970  57.630   2.280  96.600
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511081
     36.4       63.5       77.2       13.6      100.01.4135E+041.0642E+08
     49.0       97.0        2.5       75.0 3.909E-01
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511082
     36.4       63.5       76.1       13.2      100.01.3706E+049.8282E+07
     50.1       96.3        4.4       75.0 1.637E-01
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511083
     36.4       63.5       75.9       13.2      100.01.3790E+049.3996E+07
     51.0       99.1        2.3       30.0 1.570E-01

  : RUNID 511121   APR  4, 1978
    .093     .093     .094     .095     .095     .094     .094     .093     .092
    .091     .091     .092     .093     .094     .096     .097     .098     .098
    .097     .096     .096     .096     .096     .096     .096     .096     .095
    .094     .094     .094     .094     .095     .094     .094     .093     .092
    .092     .091     .091     .090     .089     .089     .088     .089     .090
    .090     .092     .092     .092     .091     .091     .092
 200
  39.980  11.500  45.820    .160  58.420   6.190  27.960   1.150 351.400
  40.200  11.570  45.740    .130  58.630   5.970  25.800    .960   4.800
  40.410  11.590  45.690    .130  59.280   6.180  24.710   1.390   7.700
  40.630  11.450  45.470    .040  59.190   5.990  24.260   1.320   6.300
 201
  41.490  11.320  44.940   -.040  58.450   8.050  31.490   1.050 356.900
  41.700  11.440  45.300    .040  58.570   8.340  31.580    .750    .400
  41.920  11.380  44.850   -.040  58.120   7.710  31.470    .760 359.600
  42.130  11.310  44.930   -.020  58.350   7.890  30.500    .720  13.800
 202
  42.990  11.290  44.530   -.130  58.490   9.070  37.350    .750 315.300
  43.210  11.180  44.570   -.020  57.770   8.840  37.800    .700 300.700
  43.420  11.270  44.540    .010  58.090   8.690  36.650    .420 308.300
  43.640  11.300  44.890    .040  58.010   9.810  37.880    .630 348.700
 203
  44.500  11.400  44.840   -.010  57.610  11.580  48.690    .560 266.400
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(Continued)

Table H-1 (cont'd)

```
44.710  11.230  44.640   -.010  57.250  12.400  47.550    .130 332.300
44.930  11.310  44.830   -.030  58.550  12.430  49.620    .950 343.500
45.140  11.330  44.690   -.010  58.200  11.950  49.680    .770 325.400
204
46.650  11.340  44.650   -.090  57.820  15.060  60.050    .390  26.200
46.860  11.250  44.480   -.070  57.120  14.480  60.740    .390 319.600
47.080  11.280  44.510   -.010  58.520  15.440  64.930    .970  17.800
47.290  11.380  44.890   -.030  58.160  14.630  62.310    .540  37.300
: RUNID 511122   APR  4, 1978
  .067    .067    .067    .066    .066    .066    .065    .065    .065
  .065    .065    .065    .064    .064    .063    .065    .066    .066
  .066    .066    .066    .066    .067    .067    .068    .068    .068
  .067    .067    .067    .067    .067    .067    .066    .067    .069
  .070    .071    .071    .071    .071    .071    .071    .070    .071
  .071    .071    .071    .071    .071    .071    .070
200
 58.470  11.930  46.980    .030  58.260   6.090  25.090    .940 318.700
 58.690  11.870  46.990   -.030  59.010   6.390  26.380   1.540 317.000
 58.900  11.880  47.190       0  58.890   6.120  22.920   1.360 314.400
 59.120  11.850  47.030    .090  58.880   6.090  25.760    .980 310.800
201
 60.190  11.920  47.330    .100  58.660   8.220  34.560   1.150 299.100
 60.410  11.940  47.090    .060  58.580   8.380  33.660   1.230 301.800
 60.620  11.980  47.140    .040  58.330   8.310  31.650    .960 304.600
 60.840  12.000  47.530    .100  59.150   8.010  35.110   1.380 293.900
202
 61.700  11.730  46.720   -.010  58.530   9.980  41.520   1.030 315.100
 61.910  11.830  46.570    .010  58.630   9.980  41.210   1.360 325.600
 62.130  11.830  46.770    .010  58.690   9.750  40.350   1.070 307.500
 62.340  11.800  46.640    .010  58.060  10.080  41.310    .730 315.600
203
 63.200  11.640  46.390   -.060  57.750  12.580  51.580    .820 315.300
 63.420  11.750  46.510    .030  57.840  13.010  50.680    .610 310.200
 63.630  11.690  46.210   -.010  57.260  12.360  51.430    .370 320.900
 63.850  11.770  46.330    .010  57.210  12.710  52.690    .340 320.900
204
 64.920  11.630  45.990   -.070  57.890  15.110  61.850    .710 296.300
 65.140  11.660  45.920   -.030  57.600  15.140  63.570    .580 301.900
 65.350  11.620  46.030   -.040  57.770  15.050  61.390    .710 315.800
 65.570  11.660  45.910       0  57.890  15.450  62.670    .780 295.600
 : RUNID 511123   APR  4, 1978
   .067    .067    .067    .066    .066    .066    .066    .065    .064
   .064    .064    .063    .064    .064    .064    .064    .063    .063
   .063    .065    .067    .067    .067    .067    .067    .067    .067
   .066    .065    .066    .065    .065    .065    .064    .064    .063
   .063    .063    .064    .063    .062    .062    .062    .062    .062
   .062    .062    .061    .061    .061    .061    .061
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511121
     36.4       63.5       68.5       19.2      100.01.9979E+049.6281E+07
     52.5      100.0        2.7       75.0 9.327E-02
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511122
     36.4       63.5       68.2       19.4      100.02.0172E+048.8680E+07
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(Continued)

Table H-1 (cont'd)

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      53.5       99.6       3.9       75.0 6.762E-02
  PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
   511123
      36.4       63.5      68.8       19.8      100.02.0578E+048.9879E+07
     128.4       79.0      12.7       75.0 6.421E-02

   : RUNID 511131   MAY 11, 1978
    5.722   5.720   5.723   5.745   5.777   5.794   5.815   5.834   5.846
    5.841   5.837   5.836   5.844   5.856   5.870   5.856   5.852   5.851
    5.856   5.860   5.868   5.864   5.846   5.842   5.842   5.849   5.863
    5.876   5.897   5.919   5.941   5.954   5.964   5.962   5.949   5.922
    5.874   5.813   5.774   5.762   5.764   5.767   5.772   5.785   5.790
    5.777   5.778   5.777   5.783   5.791   5.767   5.727
  200
   44.470   6.900  26.990    .210  60.490  11.550  47.560   1.500 295.200
   44.680   6.970  27.520    .440  60.210  11.680  47.390   1.460 291.200
   44.900   6.950  27.170    .300  60.210  11.670  47.460   1.440 303.100
   45.110   6.870  26.640    .220  60.330  11.720  46.860   1.710 288.400
  201
   46.190   7.800  30.810    .810  60.820  13.050  52.620   1.770 299.700
   46.400   7.930  31.210    .850  60.240  12.800  51.090   1.710 291.700
   46.620   8.030  31.500    .780  59.500  12.790  52.750   1.140 294.300
   46.840   7.950  30.940    .680  60.590  12.830  51.670   1.580 273.900
  202
   47.700   8.590  33.900   1.120  58.560  14.240  58.000    .290   7.800
   47.910   8.720  34.260   1.160  57.720  14.150  58.330    .140 328.600
   48.130   8.700  34.260   1.190  58.220  14.170  58.070    .340 341.800
   48.340   8.720  34.060   1.110  58.290  13.780  56.360    .490 355.900
  203
   49.850   9.560  37.290   1.530  61.140  16.500  67.350   2.060 340.800
   50.070   9.520  37.690   1.630  61.420  16.470  67.240   2.300 340.600
   50.280   9.580  38.070   1.680  61.020  16.430  65.510   2.170 337.400
   50.500   9.680  38.060   1.730  61.330  16.180  66.860   2.370 332.800
  204
   51.570  11.680  46.270   3.170  63.530  17.540  72.260   3.530 344.300
   51.790  11.110  43.750   2.610  63.610  17.860  72.080   3.680 344.800
   52.000  10.770  42.690   2.480  63.940  17.240  70.970   3.690 346.200
   52.220  10.920  43.340   2.640  63.950  17.820  72.190   3.810 346.600
   : RUNID 511132   MAY 11, 1978
    5.900   5.900   5.895   5.872   5.851   5.829   5.819   5.820   5.822
    5.800   5.764   5.757   5.751   5.747   5.743   5.747   5.760   5.773
    5.790   5.798   5.810   5.811   5.811   5.818   5.794   5.763   5.756
    5.770   5.788   5.804   5.815   5.800   5.795   5.801   5.810   5.820
    5.819   5.812   5.805   5.805   5.801   5.801   5.800   5.800   5.805
    5.817   5.825   5.832   5.840   5.842   5.844   5.840
  200
   61.260   8.120  31.820    .510  58.190   4.950  21.260    .660 293.900
   61.480   8.060  31.600    .540  58.400   5.500  22.660    .620 277.100
   61.690   8.170  31.850    .520  58.420   5.350  22.450    .500 284.800
   61.910   8.120  32.130    .430  58.970   5.250  21.940    .620 296.300
  201
   62.980   8.330  32.670    .780  58.690   5.860  25.450   1.190 296.900
   63.200   8.340  32.970    .820  58.850   5.990  26.770   1.280 300.600
   63.410   8.390  33.020    .830  59.170   5.780  25.380   1.140 290.900
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(Continued)

Table H-1 (cont'd)

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  63.630   8.380  32.920    .800  59.300   5.950  26.690   1.010 290.400
 202
  64.490   8.500  33.700    .910  58.660   8.300  34.480    .560 305.200
  64.710   8.560  33.790    .890  59.650   8.440  34.460   1.080 321.400
  64.920   8.530  33.770    .910  59.190   8.240  34.390   1.210 314.000
  65.140   8.510  33.700    .900  59.060   8.220  34.460   1.010 323.400
 203
  66.000  10.110  40.090   2.110  62.950  10.650  45.380   2.930 334.200
  66.210  10.040  39.460   1.870  61.760  11.070  45.580   2.620 342.300
  66.430  10.000  39.160   1.830  62.040  10.640  46.570   2.680 340.100
  66.640   9.600  38.040   1.590  61.750  10.920  45.880   2.450 345.400
 204
  67.930  13.060  52.030   4.260  62.720  14.430  60.010   3.090   9.500
  68.150  13.420  53.590   4.600  62.770  14.600  58.950   3.280  21.300
  68.360  14.310  56.660   5.130  62.400  14.590  59.350   2.990  39.300
  68.580  14.100  55.700   4.790  62.470  15.040  61.520   3.130  14.400
  : RUNID 511133   MAY 11, 1978
   5.601   5.599   5.593   5.575   5.568   5.569   5.570   5.579   5.603
   5.622   5.622   5.615   5.578   5.561   5.543   5.525   5.516   5.507
   5.505   5.484   5.453   5.452   5.449   5.443   5.435   5.423   5.423
   5.418   5.413   5.415   5.428   5.441   5.458   5.475   5.467   5.454
   5.445   5.452   5.466   5.473   5.468   5.463   5.475   5.476   5.468
   5.435   5.407   5.400   5.424   5.441   5.414   5.380
 200
  78.020   8.820  34.870    .860  59.670   4.850  19.010   1.490 292.300
  78.240   8.850  34.480    .890  59.610   4.280  17.800   1.560 289.600
  78.450   8.850  34.750    .930  59.930   4.050  17.560   1.430 289.200
  78.670   8.710  34.490    .900  59.070   4.280  17.380   1.070 303.400
 201
  79.530   9.020  35.660    .980  59.870   6.320  25.960   1.110 300.600
  79.740   9.120  35.870   1.010  59.640   5.840  24.540   1.330 313.400
  79.960   9.230  36.460   1.100  59.120   6.310  24.680   1.360 316.400
  80.170   9.200  36.340   1.050  59.770   6.080  25.630   1.540 308.100
 202
  81.030   9.760  38.620   1.420  59.730   8.220  32.440   1.370 345.500
  81.240   9.900  38.920   1.350  59.540   8.190  34.330   1.590 345.100
  81.460   9.770  38.720   1.230  59.600   8.400  32.760   1.410 344.200
  81.670   9.830  39.050   1.270  59.580   8.320  34.920   1.420 334.600
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511131
      36.4       63.5       75.1        9.4      92.59.7681E+035.2596E+07
      46.3       95.2        5.1       75.0 5.831E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511132
      36.4       63.5       79.2        9.3      93.09.7276E+035.9493E+07
      47.0       95.1        3.8       75.0 5.808E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511133
      36.4       63.5       81.4        9.4      91.79.7871E+036.4608E+07
      47.9       94.8        4.6       30.0 5.490E+00

  : RUNID 511141   MAY 11, 1978
   4.909   4.918   4.932   4.954   4.958   4.964   4.974   4.969   4.943
   4.929   4.924   4.931   4.938   4.946   4.954   4.940   4.892   4.858
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(Continued)

Table H-1 (cont'd)

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   4.848   4.854   4.862   4.874   4.885   4.897   4.906   4.920   4.931
   4.922   4.881   4.845   4.816   4.817   4.831   4.819   4.803   4.798
   4.799   4.800   4.780   4.748   4.727   4.706   4.698   4.693   4.695
   4.703   4.732   4.760   4.772   4.781   4.779   4.779
 200
 107.420  10.650  42.210   1.320  59.640   3.100  16.060   1.760 299.900
 107.630  10.720  42.430   1.330  60.030   3.980  15.160   1.730 301.600
 107.850  10.800  43.060   1.440  59.830   3.740  13.820   1.760 306.600
 108.060  10.770  42.500   1.290  59.840   3.620  14.440   1.800 293.900
 201
 109.130  11.690  46.070   2.140  59.140   5.120  22.450   1.650 308.200
 109.350  11.830  46.810   2.300  59.250   5.520  23.420   1.300 324.800
 109.560  11.920  46.980   2.260  58.540   5.600  22.100   1.170 329.600
 109.780  11.760  46.710   2.180  58.270   5.830  23.250    .960 326.100
 202
 110.640  12.070  48.040   2.420  58.470   7.570  31.460    .930 334.800
 110.850  12.180  48.310   2.450  59.210   7.600  30.340   1.370 332.200
 111.060  12.210  48.240   2.390  58.360   7.870  32.270   1.240 344.200
 111.280  12.160  48.170   2.310  59.170   7.790  32.540   1.240 338.600
 203
 112.780  14.210  56.420   4.160  59.950  10.890  45.530   2.180  42.400
 112.990  14.240  56.730   4.230  59.920  10.850  45.290   1.960  23.800
 113.210  14.060  55.760   4.020  59.540  11.040  45.250   1.720  16.500
 113.420  13.940  55.160   3.900  59.360  11.120  46.510   1.820  17.300
 204
 114.920  13.880  55.330   3.950  59.680  13.090  53.380   1.750  45.100
 115.140  14.000  55.660   3.970  59.190  12.990  53.770   1.760  33.100
 115.350  13.760  54.650   3.720  59.520  12.960  54.140   1.720  23.000
 115.570  13.640  54.140   3.700  59.200  13.800  54.460   1.580  30.300
  : RUNID 511142   MAY 11, 1978
   4.892   4.894   4.892   4.844   4.784   4.740   4.729   4.739   4.754
   4.769   4.799   4.832   4.857   4.871   4.889   4.906   4.924   4.935
   4.945   4.931   4.915   4.912   4.913   4.916   4.900   4.889   4.865
   4.848   4.832   4.829   4.841   4.854   4.854   4.860   4.865   4.863
   4.854   4.843   4.834   4.825   4.807   4.794   4.797   4.803   4.802
   4.809   4.821   4.839   4.851   4.854   4.854   4.863
 200
 126.290  13.000  51.240   2.370  57.970   7.020  28.780    .900 340.000
 126.510  12.750  50.790   2.200  58.190   7.020  28.590   1.200 317.100
 126.720  12.740  50.140   1.900  58.630   6.590  26.070   1.340 319.700
 126.940  12.720  50.810   2.090  58.530   7.030  26.620   1.330 307.700
 201
 127.800  13.390  53.000   2.800  58.750   8.450  35.250   1.070 322.100
 128.010  13.360  53.100   2.780  58.980   8.730  35.800   1.300 327.600
 128.220  13.490  53.430   2.850  58.660   8.790  35.920   1.460 333.700
 128.440  13.480  53.170   2.750  58.590   8.810  36.090   1.490 338.500
 202
 129.510  13.770  54.720   3.110  58.390  10.910  43.410   1.520  29.900
 129.730  13.790  54.520   3.060  59.130  10.760  44.640   1.600 341.700
 129.940  13.940  55.260   3.120  59.040  10.770  44.750   1.630 343.700
 130.160  13.950  55.350   3.300  58.690  10.720  45.020   1.300 353.200
 204
 131.440  14.280  56.610   3.460  58.500  13.840  57.060   1.490    .300
 131.660  14.400  57.240   3.690  59.010  13.830  56.730   2.080   3.100
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(Continued)

Table H-1 (cont'd)

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131.870  14.200  56.380   3.530  58.420  14.170  56.210   1.420 360.200
132.090  14.230  56.700   3.530  58.680  14.180  55.770   1.470 359.600
 : RUNID 511143   MAY 11, 1978
  4.288   4.291   4.297   4.305   4.313   4.320   4.317   4.314   4.318
  4.327   4.342   4.362   4.366   4.360   4.354   4.346   4.343   4.332
  4.313   4.295   4.288   4.295   4.303   4.321   4.352   4.371   4.365
  4.352   4.341   4.341   4.336   4.325   4.340   4.359   4.376   4.387
  4.403   4.411   4.405   4.386   4.360   4.367   4.379   4.400   4.398
  4.399   4.406   4.402   4.383   4.357   4.347   4.355
200
143.690  14.420  57.350   2.870  56.740   8.840  35.990    .620 306.900
143.910  14.500  57.370   2.780  56.890   8.860  35.340    .640 286.900
144.130  14.660  58.110   2.840  57.130   8.470  35.050    .620 320.300
144.340  14.990  59.580   2.960  56.780   9.040  36.590    .880 303.700
201
145.200  14.990  59.420   3.270  57.800  10.300  42.680   1.050 318.100
145.420  14.920  59.510   3.230  57.770  10.850  44.000   1.170 319.800
145.630  14.990  59.450   3.310  59.250  10.880  43.550   1.500 319.500
145.840  14.920  59.460   3.340  57.860  10.410  43.220   1.270 344.300
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511141
      36.4      63.5      81.4      12.9      87.61.3395E+047.9467E+07
      53.2      89.4       4.2      75.0 4.852E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511142
      36.4      63.5      82.6      13.3      87.01.3880E+047.9205E+07
      56.2      88.0       4.4      75.0 4.849E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511143
      36.4      63.5      83.4      13.6      86.81.4214E+047.6955E+07
      58.4      88.6       2.3      30.0 4.348E+00

 : RUNID 511181   MAY 12, 1978
  4.520   4.520   4.520   4.535   4.545   4.565   4.582   4.594   4.595
  4.572   4.559   4.557   4.553   4.556   4.576   4.593   4.614   4.620
  4.622   4.617   4.588   4.557   4.531   4.512   4.501   4.509   4.521
  4.539   4.551   4.571   4.588   4.591   4.593   4.588   4.590   4.609
  4.634   4.650   4.658   4.661   4.652   4.667   4.676   4.698   4.720
  4.716   4.717   4.702   4.699   4.701   4.720   4.728
200
 23.120  10.270  40.350    .210  64.250  11.120  44.850   1.070 357.400
 23.330  10.310  40.660    .160  64.400  11.090  44.670   1.050 357.600
 23.550  10.290  40.610    .220  64.100  10.230  43.150   1.090 344.500
 23.760  10.320  40.840    .180  64.310  10.670  43.890   1.210 350.400
201
 24.840  10.210  40.390    .170  64.880  11.820  48.620   1.670  33.400
 25.050  10.360  40.810    .220  65.320  11.980  48.410   1.910  16.500
 25.270  10.320  40.660    .220  64.930  11.380  47.980   1.560   8.500
 25.480  10.350  40.850    .230  64.380  11.690  47.840   1.540  35.800
202
 26.340  11.390  45.860    .950  65.730  13.280  52.960   1.410 338.500
 26.560  10.770  42.300    .120  66.220  13.430  54.390   1.850  49.600
 26.770  10.510  41.370    .190  65.130  12.810  54.360   1.920  34.600
 26.990  10.640  41.990    .420  64.780  12.880  52.410   1.440  28.300
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(Continued)

Table H-1 (cont'd)

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 203
  28.280  13.430  53.680   2.120  62.950  14.910  61.450   1.600 327.500
  28.490  13.110  51.300   1.380  67.830  15.010  61.210   2.280 280.400
  28.710  11.550  46.750   1.500  65.270  14.890  62.200   1.970 276.900
  28.920  12.570  51.040   1.800  65.680  15.110  61.660   2.380 320.600
 204
  30.430  14.300  56.950   1.640  66.570  17.520  71.470   3.390 247.900
  30.640  13.690  54.170   1.580  65.530  17.770  71.450   1.520 280.200
  30.860  13.160  51.930   1.450  65.460  17.610  72.220   1.680 217.300
  31.070  13.310  52.750   1.650  64.400  17.600  70.700    .910 277.100
  : RUNID 511182   MAY 12, 1978
   4.160   4.158   4.156   4.131   4.123   4.121   4.112   4.125   4.150
   4.184   4.184   4.159   4.142   4.118   4.123   4.116   4.102   4.090
   4.102   4.108   4.091   4.062   4.051   4.047   4.039   4.028   4.018
   4.008   4.008   4.027   4.035   4.048   4.067   4.071   4.079   4.088
   4.097   4.111   4.132   4.164   4.170   4.181   4.173   4.159   4.138
   4.135   4.146   4.147   4.135   4.121   4.113   4.113
 200
    .720  11.050  43.900    .390  62.470   8.250  31.130    .940 339.100
    .930  10.960  43.830    .330  62.710   8.440  34.630   1.290 345.900
   1.150  11.010  43.410    .290  62.340   8.220  32.380    .830 351.400
   1.360  11.010  43.680    .410  62.210   8.180  33.460    .790  12.300
 201
   2.230  11.290  44.360    .510  62.400   9.720  40.990   1.370  51.400
   2.440  11.240  44.290    .490  62.670  10.080  40.540   1.170  24.000
   2.660  11.220  44.240    .480  62.590   9.220  38.880    .910  52.000
   2.870  11.200  44.340    .480  62.130   9.800  40.380    .760  35.000
 202
   3.730  11.860  47.740   1.320  62.990  11.310  48.960   1.870 109.500
   3.950  11.720  46.010    .660  64.630  11.840  47.840   1.890  59.200
   4.160  11.450  45.030    .900  63.400  11.460  48.690   1.970  85.200
   4.380  11.320  44.760    .540  63.980  11.830  48.000   1.820  75.500
 203
   5.240  12.840  50.350   1.010  62.610  14.110  56.720   1.270  95.300
   5.450  12.770  49.600    .970  61.750  14.330  59.170    .360  79.300
   5.670  12.090  47.720    .480  63.140  14.140  58.020   1.430 195.600
   5.890  11.750  46.820    .730  62.320  14.020  57.520   1.390 108.300
 204
   7.610  13.910  54.810   1.260  65.800  17.220  70.890   2.590 163.700
   7.820  13.830  54.730   1.510  65.050  17.070  71.080   3.240  56.100
   8.040  13.850  55.790   1.910  65.150  17.390  72.060   2.980 145.700
   8.250  13.580  54.660   1.560  67.040  17.690  72.310   3.410  68.600
  : RUNID 511183   MAY 12, 1978
   3.057   3.057   3.062   3.083   3.093   3.103   3.102   3.101   3.111
   3.124   3.132   3.139   3.140   3.145   3.155   3.174   3.206   3.232
   3.249   3.258   3.257   3.253   3.263   3.291   3.312   3.314   3.301
   3.298   3.309   3.320   3.320   3.312   3.301   3.306   3.309   3.316
   3.323   3.343   3.359   3.371   3.386   3.386   3.392   3.384   3.371
   3.353   3.351   3.353   3.340   3.312   3.288   3.285
 200
  17.290  11.550  45.900    .560  61.620   7.650  34.520   1.060 303.800
  17.510  11.590  45.810    .610  61.700   8.190  31.680   1.030 315.800
  17.720  11.650  46.120    .620  61.570   8.270  34.530   1.030 316.300
  17.940  11.600  45.900    .600  61.680   8.380  34.520    .980 311.900
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(Continued)

Table H-1 (cont'd)

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 201
  18.800  11.670  46.380    .580  61.600  10.060  41.330    .820  14.000
  19.010  11.710  46.500    .620  61.200  10.000  41.030    .720    .300
  19.230  11.700  46.600    .570  61.950   9.460  40.580    .970    .400
  19.440  11.800  46.720    .610  61.700   9.900  39.200    .800    .500
 202
  20.520  13.260  52.790   1.490  60.940  11.310  45.970   1.010 130.800
  20.730  13.300  52.870   1.500  61.440  12.320  49.290    .740 170.900
  20.950  13.570  53.470   1.490  61.070  11.560  47.070    .770  88.600
  21.160  13.810  54.250   1.470  62.650  11.240  46.520   1.600  91.900
 203
  22.460  14.250  56.620   1.650  60.020  14.710  58.030    .050  78.000
  22.670  14.440  56.860   1.740  60.090  14.370  58.100    .060 118.100
  22.890  14.430  57.100   1.770  59.780  14.340  58.880       0  88.700
  23.100  14.110  55.720   1.490  60.770  14.560  60.280    .560  37.700
 204
  24.180  14.770  59.000   1.980  63.250  15.690  63.320   1.220 234.900
  24.390  14.400  56.770   1.410  62.210  15.160  62.900    .930 293.300
  24.610  13.800  54.870   1.230  60.010  15.420  64.450    .480 243.200
  24.820  13.730  54.300   1.460  61.480  15.860  64.360   1.060 316.500
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511181
      36.4       63.5       68.1       20.2       92.82.1026E+047.7374E+07
      50.6       98.9        5.5       75.0 4.603E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511182
      36.4       63.5       70.2       19.7       91.02.0565E+048.5675E+07
      52.2       97.6        3.5       75.0 4.109E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511183
      36.4       63.5       71.2       19.9       91.42.0767E+048.9647E+07
      52.9       97.1        3.4       30.0 3.252E+00


  : RUNID 511201    MAY 17, 1978
   5.499    5.495    5.492    5.489    5.439    5.496    5.494    5.486    5.494
   5.506    5.515    5.520    5.525    5.531    5.533    5.536    5.537    5.530
   5.533    5.545    5.553    5.553    5.552    5.555    5.560    5.562    5.564
   5.563    5.569    5.575    5.571    5.579    5.591    5.602    5.595    5.584
   5.575    5.582    5.597    5.613    5.619    5.610    5.590    5.570    5.558
   5.565    5.582    5.597    5.603    5.614    5.635    5.651
 200
  12.160   7.480  28.560    .130  63.410  12.160  48.980   1.330 304.500
  12.370   7.360  28.560    .180  63.830  12.140  49.510   1.510 300.900
  12.590   7.160  27.890    .090  63.750  12.100  49.610   1.410 300.700
  12.800   7.270  28.320    .200  63.530  12.010  49.210   1.230 313.600
 201
  13.660   7.660  30.240    .350  63.310  13.550  56.010   1.370 337.700
  13.870   7.640  30.250    .310  62.800  13.610  55.440   1.220 344.300
  14.090   7.680  30.430    .300  63.080  13.540  55.870   1.300 343.000
  14.300   7.740  30.690    .290  62.950  13.640  55.630   1.160 337.900
 202
  15.160   8.340  32.520    .420  63.540  15.330  63.290   1.650 329.400
  15.380   8.250  32.490    .350  63.880  15.450  62.630   1.740 334.800
  15.590   8.500  33.340    .380  63.770  15.040  61.170   1.630 334.700
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(Continued)

Table H-1 (cont'd)

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  15.810   8.580  33.510    .450  63.970  14.970  62.900   1.890 324.200
 203
  16.880   9.740  38.600    .830  64.190  17.540  72.430   2.150 340.100
  17.100   9.800  38.710    .800  64.340  17.720  72.050   2.110 334.100
  17.310   9.830  38.630    .810  64.050  17.740  71.640   2.090 337.700
  17.530   9.680  38.290    .710  64.140  17.770  71.850   1.990 336.100
 204
  19.250  10.920  42.890   1.460  60.740  22.210  86.660    .370 320.200
  19.460  10.730  42.450   1.360  60.610  21.780  88.000   -.020 289.300
  19.680  10.960  43.110   1.480  60.310  21.540  87.870   -.020 320.600
  19.890  10.850  42.830   1.420  60.290  21.820  87.750   -.010 297.400
  : RUNID 511202   MAY 17, 1978
   5.001   5.004   5.008   5.014   4.999   4.989   4.989   4.993   4.975
   4.973   4.978   4.996   5.003   5.028   5.040   5.047   5.057   5.067
   5.081   5.068   5.050   5.036   5.045   5.044   5.044   5.026   5.005
   4.988   4.986   4.992   5.009   5.024   5.025   5.026   5.027   5.028
   5.028   5.034   5.041   5.042   5.055   5.068   5.096   5.120   5.138
   5.155   5.172   5.186   5.164   5.132   5.112   5.102
 200
  30.210   7.580  29.690    .320  62.370   6.750  29.480   1.420 283.200
  30.420   7.570  30.110    .330  61.960   7.370  29.560   1.120 275.400
  30.640   7.800  30.140    .390  61.550   7.330  36.880   1.060 292.400
  30.850   7.770  30.450    .400  62.080   7.230  30.160   1.140 304.200
 201
  31.710   7.730  30.060    .330  62.680   8.750  36.450   1.710 298.800
  31.920   7.710  29.950    .280  62.050   9.030  34.620   1.440 292.500
  32.140   7.790  30.540    .330  61.480   8.870  37.150    .970 280.200
  32.350   7.680  30.100    .240  61.720   8.390  34.680   1.120 282.700
 202
  33.210   7.970  31.340    .290  61.010   9.970  42.150    .980 337.300
  33.430   8.820  34.350    .770  62.650  10.390  41.910   1.440 341.200
  33.640   8.710  34.290    .500  62.080  10.180  43.200   1.220 351.800
  33.860   8.510  33.790    .420  61.600  10.240  40.820   1.220 344.000
 203
  34.930   9.820  38.690    .810  64.770  13.250  54.240   2.950 341.200
  35.150   9.880  39.070    .820  64.470  12.320  54.110   2.850 339.800
  35.360   9.800  38.510    .690  64.420  13.410  52.480   2.830 341.700
  35.580   9.600  37.870    .590  64.290  13.180  53.680   2.810 337.100
 204
  36.870  11.560  45.620   1.920  60.770  17.980  74.140    .850 350.200
  37.080  11.300  44.950   1.780  60.450  17.850  70.200    .510   7.300
  37.300  11.360  45.220   1.780  60.600  18.390  74.160    .830 346.500
  37.510  11.400  45.020   1.680  60.770  18.120  73.920    .730 360.200
  : RUNID 511203   MAY 17, 1978
   4.647   4.652   4.661   4.669   4.661   4.675   4.702   4.735   4.752
   4.768   4.785   4.773   4.764   4.763   4.770   4.782   4.791   4.801
   4.814   4.828   4.841   4.855   4.868   4.870   4.855   4.845   4.835
   4.808   4.775   4.742   4.724   4.737   4.767   4.800   4.831   4.854
   4.879   4.913   4.945   4.953   4.943   4.936   4.929   4.913   4.914
   4.901   4.893   4.912   4.913   4.887   4.864   4.854
 200
  47.180   9.250  36.140    .600  60.670   6.640  29.280    .840 305.000
  47.400   9.160  35.970    .510  61.010   7.020  31.320    .710 295.900
  47.610   9.140  35.950    .560  60.020   6.980  29.280    .510 307.000
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(Continued)

Table H-1 (cont'd)

```
 47.830   9.010  35.450    .450  60.570   7.000  29.410    .690 322.800
201
 49.120   9.520  37.520    .670  60.790   9.090  37.440    .690 351.800
 49.330   9.470  37.350    .600  60.570   8.860  36.140    .740    .300
 49.550   9.400  36.970    .490  60.170   8.650  37.110    .510 359.200
 49.760   9.380  36.970    .490  60.160   8.750  36.340    .500 352.300
202
 50.840   9.560  37.910    .540  60.520   9.540  41.250    .560 360.100
 51.050   9.710  38.230    .570  60.850  10.670  42.150    .830   6.700
 51.270   9.600  38.070    .540  60.110  10.500  42.580    .450   1.000
 51.480   9.660  37.970    .530  60.280  10.810  43.730    .630   8.200
203
 52.340   9.970  39.500    .790  62.160  13.310  51.980   2.000 359.300
 52.560  10.050  39.960    .760  61.310  12.830  52.660   1.080 341.400
 52.770  10.010  39.590    .690  61.550  12.870  52.310   1.320 351.700
 52.990  10.010  39.560    .770  61.250  13.110  53.590   1.180   1.300
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511201
     36.4      63.5      74.8      13.5      90.21.4077E+047.1948E+07
     45.8      98.0       4.1      75.0 5.556E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511202
     36.4      63.5      75.8      13.5      89.51.4106E+047.9971E+07
     45.9      98.2       4.3      75.0 5.044E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511203
     36.4      63.5      77.6      13.6      87.21.4115E+048.0266E+07
     48.5      97.0       2.3      30.0 4.814E+00

  : RUNID 511241    MAY 17, 1978
   1.721    1.721    1.720    1.728    1.752    1.769    1.779    1.780    1.771
   1.755    1.746    1.758    1.780    1.801    1.807    1.803    1.802    1.805
   1.817    1.817    1.811    1.820    1.838    1.842    1.834    1.826    1.830
   1.833    1.850    1.863    1.854    1.839    1.835    1.835    1.830    1.818
   1.794    1.769    1.741    1.716    1.707    1.706    1.694    1.680    1.684
   1.688    1.692    1.709    1.719    1.713    1.702    1.696
 200
  81.560  11.330  44.460    .780  60.150   7.140  27.530    .500 294.600
  81.780  10.930  43.350    .790  60.430   7.200  29.610    .690 267.500
  81.990  10.960  43.650    .900  60.050   7.110  29.320    .520 267.600
  82.210  11.000  43.570    .950  60.620   7.210  29.900    .720 270.900
 201
  83.070  11.320  44.420   1.020  59.860   8.990  35.910    .820 289.600
  83.280  11.200  44.320   1.030  59.730   9.030  37.650    .430 301.600
  83.500  11.150  44.530   1.020  59.770   8.580  36.810    .320 305.500
  83.710  11.280  44.880   1.120  59.990   8.570  37.320    .490 320.300
 202
  84.360  11.530  45.310   1.270  60.320  11.060  43.050    .760 323.500
  84.570  11.310  45.200   1.140  60.480  10.680  43.880    .610   4.700
  84.790  11.470  45.370   1.210  60.020  11.260  44.520    .820  10.800
  85.000  11.750  46.560   1.300  60.300  10.970  44.400    .640   5.700
 203
  85.860  12.300  48.620   1.690  62.570  13.240  55.940   1.770   4.100
  86.080  12.290  48.740   1.700  61.130  13.660  54.840   1.360   9.900
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(Continued)

Table H-1 (cont'd)

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  86.290  12.340  49.170   1.740  61.510  14.190  57.740   1.570   5.900
  86.510  12.380  49.090   1.750  61.660  13.830  56.940   1.610  10.600
 204
  87.800  13.590  54.330   2.340  64.190  19.890  79.910   2.490  40.000
  88.010  14.050  55.350   1.570  63.770  19.160  80.940   3.410  54.400
  88.230  13.800  55.250   1.720  64.330  19.490  81.750   4.450  80.200
  88.440  14.180  55.720   1.500  63.900  19.680  78.710   3.210  20.700
  : RUNID 511242   MAY 17, 1978
   1.435   1.437   1.439   1.448   1.447   1.448   1.445   1.432   1.425
   1.433   1.433   1.437   1.429   1.437   1.440   1.437   1.431   1.421
   1.416   1.421   1.426   1.428   1.429   1.423   1.414   1.402   1.392
   1.386   1.380   1.369   1.354   1.344   1.339   1.332   1.339   1.350
   1.362   1.379   1.395   1.398   1.395   1.404   1.413   1.420   1.436
   1.444   1.453   1.453   1.447   1.433   1.404   1.380
 200
  97.040  12.570  49.770   1.380  60.060   9.480  39.420    .660 326.100
  97.250  12.630  50.060   1.460  60.720   9.660  38.940    .720 319.600
  97.470  12.760  50.640   1.480  60.260   9.130  39.950    .750 306.800
  97.680  12.800  50.900   1.550  60.070   9.990  40.090    .880 303.200
 201
  98.540  12.750  50.630   1.530  59.840  11.590  45.990    .510 350.400
  98.760  12.760  50.930   1.560  59.770  11.650  46.690    .360   1.100
  98.970  12.800  50.750   1.550  60.410  11.350  48.180    .780 360.000
  99.190  13.040  51.510   1.700  60.470  11.690  46.860    .710 359.900
 202
 100.050  13.060  52.000   1.780  60.840  13.710  56.550    .900 359.000
 100.260  13.060  51.850   1.810  61.190  13.590  56.570   1.280   5.500
 100.480  13.200  52.740   1.890  60.930  13.350  54.600   1.080 355.600
 100.690  13.170  52.010   1.790  60.740  13.870  55.600   1.030  13.800
 203
 101.770  13.290  52.870   1.950  61.540  16.890  68.250   1.410  11.800
 101.980  13.300  52.820   1.980  61.350  16.950  69.160   1.550  39.000
 102.200  13.290  52.720   1.940  62.020  17.020  68.610   1.530   2.300
 102.410  13.230  52.750   1.970  61.020  16.830  68.610   1.230  13.300
 204
 103.270  13.650  54.400   2.350  61.730  19.700  80.020   1.170 348.900
 103.490  13.470  53.730   2.200  62.690  19.790  80.540   1.710  10.800
 103.700  13.710  54.780   2.350  61.920  19.680  77.670   1.980  50.200
 103.920  14.170  56.170   2.690  62.920  19.610  79.850   -.010  52.600
  : RUNID 511243   MAY 17, 1978
   1.178   1.179   1.182   1.195   1.210   1.225   1.227   1.226   1.229
   1.230   1.230   1.231   1.227   1.222   1.222   1.222   1.225   1.232
   1.242   1.246   1.243   1.242   1.246   1.246   1.247   1.251   1.256
   1.263   1.271   1.268   1.260   1.253   1.248   1.235   1.212   1.200
   1.194   1.189   1.190   1.194   1.189   1.180   1.180   1.184   1.178
   1.172   1.172   1.175   1.183   1.185   1.186   1.184
 200
 112.940  13.690  54.300   1.720  60.260  10.890  44.560    .710 289.200
 113.160  13.790  54.700   1.840  60.100  10.480  41.730    .600 285.200
 113.370  13.550  53.630   1.770  59.830  10.640  44.500    .490 262.600
 113.590  13.600  54.180   1.830  59.770  10.880  43.780    .490 269.300
 201
 114.230  13.760  54.470   1.910  60.500  12.620  50.600    .580 304.500
 114.450  13.760  54.750   1.900  59.570  12.470  51.880    .410 270.900
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(Continued)

Table H-1 (cont'd)

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 114.660  13.710  54.680   1.890  59.380  12.610  51.660     .520 239.400
 114.880  13.760  54.310   1.850  59.720  12.710  52.060     .440 258.300
 202
 115.740  13.830  54.650   1.990  61.000  14.470  59.320     .690 263.500
 115.950  13.830  54.390   2.020  60.460  14.540  59.190   1.040 272.300
 116.170  13.940  55.660   2.170  60.290  14.300  58.400     .780 233.600
 116.380  13.890  55.070   1.980  60.100  14.140  57.560     .880 254.200
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511241
      36.4      63.5      74.1      19.7      85.82.0490E+041.0319E+08
      52.2      94.8       1.7      75.0 1.773E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511242
      36.4      63.5      75.6      19.7      85.02.0537E+041.0136E+08
      55.1      93.0       1.9      75.0 1.412E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511243
      36.4      63.5      76.5      19.9      84.42.0682E+041.0213E+08
      56.6      92.5       1.9      30.0 1.216E+00

  : RUNID 511301   MAR 18, 1978
   1.323   1.315   1.303   1.269   1.236   1.217   1.213   1.216   1.220
   1.214   1.211   1.211   1.203   1.200   1.200   1.201   1.191   1.178
   1.170   1.171   1.178   1.188   1.195   1.192   1.189   1.183   1.175
   1.174   1.174   1.179   1.186   1.196   1.207   1.217   1.227   1.236
   1.247   1.258   1.267   1.273   1.275   1.273   1.267   1.258   1.246
   1.227   1.210   1.200   1.191   1.181   1.172   1.164
 200
 152.320   3.110  12.140   3.720  87.760 -10.910  24.220   1.790 352.500
 152.540   3.300  12.470   3.690  87.840       0  28.140   1.770   3.200
 152.750   3.120  12.500   3.710  87.780 -10.350  24.280   1.710 297.000
 152.970   3.280  11.940   3.760  87.910 -10.500  25.810   2.800 352.300
 201
 154.050   2.810  10.580   3.600  87.680  -8.450    .950   3.470  12.500
 154.260   2.710  10.290   3.630  87.780  -8.490  12.030   3.580 354.400
 154.480   3.030  11.290   3.760  87.930  -7.470  -6.590   3.180  13.100
 154.690   2.960  11.260   3.740  87.860  -8.220       0   3.250 347.500
 204
 155.990   2.910  10.780   3.510  87.730  -6.660       0   2.570 328.700
 156.200   2.960  10.890   3.530  87.880  -6.130       0   2.270   8.600
 156.420   2.810  10.860   3.530  87.710  -6.170   1.340    .230 340.900
 156.640   3.170  11.780   3.560  87.830  -6.340       0   2.710 347.200
  : RUNID 511272   MAR 18, 1978
   1.269   1.271   1.275   1.284   1.281   1.284   1.293   1.303   1.313
   1.323   1.332   1.340   1.349   1.357   1.366   1.374   1.382   1.389
   1.395   1.399   1.405   1.413   1.419   1.423   1.427   1.432   1.439
   1.448   1.458   1.467   1.475   1.481   1.486   1.491   1.496   1.501
   1.506   1.512   1.519   1.524   1.529   1.533   1.540   1.545   1.547
   1.551   1.553   1.557   1.561   1.565   1.566   1.568
 200
 166.560   3.310  12.400   3.610  87.880 -11.000  25.730    .010 335.600
 166.780   3.310  12.440   3.530  87.700 -10.360  26.230    .010 326.800
 166.990   3.240  12.360   3.580  87.890 -10.080  23.720    .020 346.700
 167.210   3.330  12.820   3.580  87.880 -10.410  25.660    .020 307.800
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(Continued)

Table H-1 (cont'd)

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 201
 168.070   2.660  10.500   3.650  87.300  -9.670  10.130    .040 286.600
 168.290   2.610   9.710   3.460  87.880  -8.560  23.480    .010 303.100
 168.500   2.240   8.900   3.400  87.710  -8.390  23.090       0 294.300
 168.720   2.430   8.880   3.500  87.840  -9.290  23.420       0 293.400
 204
 170.010   2.210   8.330   3.450  87.930  -7.650  13.470    .010 291.800
 170.230   2.260   8.540   3.500  87.770  -7.880  15.900    .010 289.400
 170.440   2.250   8.510   3.530  87.770  -7.780  -2.960    .040 290.400
 170.660   2.220   8.450   3.530  87.720  -8.060  24.440       0 295.100
  : RUNID 511273    MAR 18, 1978
   1.057   1.060   1.064   1.075   1.086   1.097   1.110   1.126   1.137
   1.147   1.157   1.164   1.164   1.167   1.176   1.187   1.198   1.198
   1.194   1.183   1.180   1.186   1.192   1.185   1.179   1.183   1.194
   1.206   1.216   1.226   1.239   1.250   1.261   1.270   1.277   1.285
   1.295   1.306   1.317   1.326   1.333   1.341   1.347   1.353   1.361
   1.372   1.381   1.388   1.394   1.398   1.402   1.408
 200
 180.590   2.820  10.570   3.630  87.910       0  27.160    .040 312.200
 180.800   2.980  11.160   3.730  87.850       0  27.590    .030 289.300
 181.020   2.860  11.040   3.650  87.780       0  29.450    .010 325.800
 181.230   2.980  11.570   3.710  87.690       0  26.310    .020 310.600
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511301
      36.4      63.5      64.6      31.7     100.03.2975E+041.6934E+08
      37.2      71.3      11.1      75.0 1.217E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511272
      36.4      63.5      65.2      32.1     100.03.3471E+041.6811E+08
      36.5      72.0        .0      75.0 1.433E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511273
      36.4      63.5      65.9      31.8     100.03.3151E+041.7233E+08
      37.2      71.4        .1      30.0 1.231E+00

  : RUNID 511311    APR 25, 1978
   4.329   4.328   4.321   4.302   4.311   4.299   4.250   4.222   4.236
   4.252   4.275   4.313   4.348   4.362   4.392   4.425   4.454   4.435
   4.393   4.380   4.381   4.384   4.417   4.446   4.442   4.458   4.467
   4.510   4.505   4.481   4.472   4.462   4.474   4.510   4.533   4.530
   4.522   4.489   4.479   4.454   4.442   4.415   4.411   4.376   4.354
   4.370   4.400   4.438   4.476   4.440   4.378   4.319
 200
  39.870  14.110  56.340    .590  61.600   7.620  29.650   2.150  22.200
  40.090  14.130  56.300    .630  60.870   7.260  29.420   1.960   3.200
  40.300  14.170  56.410    .630  60.780   7.640  29.910   1.510  23.700
  40.520  14.290  56.690    .570  60.520   7.350  29.500   1.450  21.200
 201
  41.370  14.030  55.810    .680  61.800   9.060  36.700   2.700  30.300
  41.590  13.970  55.750    .690  61.700   8.720  35.440   2.730  47.800
  41.800  13.960  55.560    .670  63.410   8.410  35.900   4.170  15.400
  42.010  13.960  55.520    .710  63.070   9.150  37.020   2.710  49.000
 202
  42.870  15.290  60.740    .930  63.350  10.260  43.390   3.590  41.800
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(Continued)

Table H-1 (cont'd)

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 43.090  13.950  55.450    .270  63.940   9.990  41.760   3.000  21.100
 43.300  13.930  55.130    .610  65.160  10.360  43.530   3.840  66.200
 43.510  13.820  54.970    .690  63.080  10.220  44.820   3.740  30.900
204
 44.800  13.700  54.590    .780  64.040  12.940  53.050   3.840  83.200
 45.010  13.760  54.480    .800  62.500  12.960  53.850   3.110  38.800
 45.230  14.070  59.370    .750  63.820  13.250  54.830   2.940  52.800
 45.440  13.740  54.520    .340  63.820  12.980  53.520   3.390  95.900
 : RUNID 511312   APR 25, 1978
  3.802   3.799   3.795   3.807   3.846   3.890   3.935   3.966   3.960
  3.957   3.985   4.028   4.054   4.048   3.977   3.886   3.859   3.845
  3.827   3.796   3.790   3.822   3.871   3.925   3.978   4.041   4.096
  4.105   4.102   4.126   4.175   4.202   4.230   4.218   4.219   4.234
  4.254   4.249   4.218   4.169   4.157   4.145   4.102   4.036   3.961
  3.933   3.967   3.978   3.942   3.911   3.916   3.939
200
 56.580  14.160  56.550    .750  58.160   7.890  30.850    .560    .600
 56.790  14.180  56.330    .680  60.180   7.520  32.670   1.230   8.900
 57.010  14.090  56.220    .700  58.740   7.350  30.310   1.100 360.100
 57.220  14.410  56.670    .660  59.630   7.550  31.370    .970   5.200
201
 58.080  14.040  55.680    .710  60.760   9.900  39.020   2.500  70.400
 58.290  14.050  55.600    .690  60.810   9.880  38.730   2.050  47.700
 58.510  14.020  55.740    .660  60.210   9.820  38.970   2.070  29.400
 58.720  14.010  55.840    .640  59.790   9.350  39.030   2.210  59.900
202
 59.790  14.690  58.230   -.330  62.460  11.400  45.410   3.720  38.200
 60.010  13.940  55.370   -.330  59.830  11.750  46.160   1.090  56.100
 60.220  13.970  56.020    .310  59.570  11.200  46.770   2.020  28.200
 60.430  13.880  54.940    .310  61.270  11.820  47.420   1.980  41.100
203
 61.720  14.480  57.980    .160  61.820  14.590  56.050   2.320 115.300
 61.930  16.890  65.530    .550  62.280  14.180  54.570   3.170  64.700
 62.150  16.270  59.060   -.810  62.400  14.070  55.620   3.930  56.700
 62.360  16.500  62.040  -1.110  62.670  13.330  56.980   3.020  63.300
204
 63.220  13.520  53.590    .410  64.710  15.570  63.890   4.110  61.600
 63.430  13.430  53.590    .440  63.380  15.250  62.050   4.000  63.900
 63.650  13.440  53.500    .440  62.950  15.690  63.160   3.720  28.900
 63.860  13.450  53.510    .420  63.700  15.130  61.650   3.460  93.600
 : RUNID 511313   APR 25, 1978
   .988    .984    .979    .965    .965    .969    .963    .953    .941
   .929    .915    .903    .892    .881    .870    .857    .844    .842
   .837    .829    .821    .813    .806    .797    .788    .780    .771
   .778    .800    .853    .895    .975   1.069   1.120   1.156   1.166
  1.158   1.142   1.124   1.108   1.089   1.072   1.074   1.117   1.139
  1.137   1.120   1.137   1.203   1.264   1.283   1.276
200
 74.360  14.440  57.690    .900  61.610   7.540  32.080   1.740  90.200
 74.570  14.450  57.690    .860  66.200   7.530  33.250   2.550  11.800
 74.790  14.380  57.280    .850  59.600   7.310  29.660   2.580  41.100
 75.000  14.300  57.130    .860  61.590   8.340  32.560   2.710 115.400
201
 76.070  14.160  56.600    .760  60.200   8.740  37.510   2.950 137.600
```

(Continued)

Table H-1 (cont'd)

```
  76.290  14.180  56.750    .900  60.290   9.010  38.090   1.890 139.900
  76.500  14.630  58.980    .910  60.860   9.220  38.300   2.140  28.800
  76.710  14.330  56.700    .630  61.460   9.420  37.690   2.380 128.800
 202
  77.570  14.490  57.810   1.060  61.870  10.130  39.760   5.040  38.100
  77.790  14.980  57.780   -.500  62.450  10.850  43.990   4.560   8.700
  78.000  14.060  56.510    .490  62.580  10.540  43.200   2.980  36.800
  78.210  15.490  62.600   1.420  60.910  10.040  41.320   5.400  75.800
 204
  79.500  13.540  53.900    .510  65.420  13.050  52.600   5.400  95.100
  79.710  15.680  61.200   -.010  63.400  12.740  52.620   5.420  59.200
  79.930  14.740  61.170    .850  65.290  13.430  53.580   3.630  69.400
  80.140  14.630  56.560   -.520  63.400  13.840  55.090   3.750  83.000
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511311
      36.4      63.5      91.2       8.5     100.08.8596E+035.2071E+07
      57.2      97.2      10.1      75.0 4.402E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511312
      36.4      63.5      91.2       8.7      99.99.1053E+035.3502E+07
      57.3      97.2       7.2      75.0 4.001E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511313
      36.4      63.5      91.2       8.5     100.08.8647E+035.9054E+07
      57.9      96.5       7.9      30.0 9.834E-01

  : RUNID 511321   APR 25, 1978
   5.735   5.728   5.716   5.698   5.693   5.698   5.705   5.685   5.648
   5.643   5.648   5.631   5.590   5.579   5.587   5.607   5.639   5.677
   5.716   5.738   5.708   5.683   5.647   5.627   5.622   5.601   5.548
   5.478   5.428   5.374   5.322   5.296   5.286   5.284   5.288   5.307
   5.331   5.348   5.365   5.377   5.371   5.334   5.280   5.255   5.256
   5.245   5.256   5.280   5.303   5.316   5.331   5.344
 200
 112.490  14.370  57.050    .800  60.110   7.930  31.010   2.240  57.000
 112.700  14.390  57.230    .870  60.190   8.160  34.110   2.900  93.500
 112.920  14.420  57.360    .890  59.610   7.940  32.740   1.990 113.300
 113.130  14.430  57.050    .980  60.940   7.900  33.080   2.360 189.800
 201
 113.990  14.560  57.600    .760  58.830   8.570  35.980   4.440  18.800
 114.200  14.260  56.200    .580  61.260   9.870  40.490   5.480  74.300
 114.420  14.230  56.680    .900  63.190   9.460  38.980   2.490  14.600
 114.630  14.260  56.650    .880  61.000   9.540  41.070   2.910  23.600
 202
 115.700  14.510  59.130    .860  62.040  10.810  45.580   2.300  23.900
 115.910  14.790  58.780    .280  62.940  11.240  46.010   2.550  67.500
 116.130  14.590  57.440    .170  65.970  10.940  46.870   5.670  82.000
 116.340  14.350  57.190    .640  60.730  11.480  46.510   3.680  72.900
 203
 117.630  14.370  56.800    .220  64.510  13.310  55.870   4.180  16.800
 117.840  13.890  55.550    .790  62.250  13.400  54.570   4.160  64.800
 118.060  14.310  56.760    .720  61.380  13.910  54.890   2.830  25.900
 118.270  14.480  56.070   -.320  63.250  12.930  52.260   4.590 115.400
 204
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(Continued)

Table H-1 (cont'd)

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119.130  13.540  53.970    .510  65.830  13.420  54.540   5.150  68.300
119.340  14.650  56.630    .190  63.170  14.190  58.090   3.530  27.200
119.560  13.560  53.950    .110  64.160  13.650  57.080   5.390  72.700
119.770  15.250  59.760    .350  64.630  14.480  60.200   4.020  16.300
 : RUNID 511322   APR 25, 1978
  4.371   4.372   4.369   4.343   4.331   4.303   4.266   4.240   4.234
  4.221   4.180   4.118   4.044   3.972   3.913   3.886   3.885   3.909
  3.927   3.911   3.915   3.938   3.971   3.997   4.027   4.073   4.121
  4.155   4.140   4.125   4.117   4.093   4.073   4.036   3.998   3.982
  3.956   3.976   3.996   3.984   3.970   3.936   3.886   3.831   3.782
  3.772   3.787   3.789   3.797   3.805   3.783   3.791
200
130.910  14.220  56.870    .870  59.090   7.490  30.150    .960  53.000
131.120  14.350  56.780    .780  58.950   7.760  31.900   2.130  34.700
131.340  14.240  56.930    .840  59.030   7.490  29.480   2.200  52.100
131.550  14.190  56.360    .840  59.920   7.650  34.100   1.860  31.700
201
132.620  14.070  55.890    .800  58.370   9.280  38.280   3.000    .300
132.830  13.960  55.660    .850  59.910   9.060  36.760   2.480  31.100
133.050  14.140  56.000    .800  61.320   9.920  39.960   4.380  16.100
133.260  13.990  55.820    .880  62.440   9.430  37.830   4.520   9.500
202
134.330  14.880  58.490    .470  61.170  10.890  44.740   4.610  68.700
134.550  13.860  55.260    .610  61.600  11.390  44.590   4.620  51.500
134.760  14.110  55.860    .830  64.190  11.020  42.730   5.120  54.100
134.980  13.950  55.470    .710  64.980  11.760  45.980   4.570  32.200
204
136.050  13.770  54.640    .670  64.850  13.620  56.100   4.900  20.700
136.260  13.850  55.700   1.120  63.690  12.980  53.940   5.040  71.900
136.480  13.750  54.290    .800  66.290  12.910  51.960   5.950  20.400
136.690  14.160  55.550    .440  64.970  12.420  49.340   6.630 103.100
 : RUNID 511323   APR 25, 1978
  3.851   3.860   3.869   3.903   3.957   4.018   4.071   4.111   4.154
  4.200   4.238   4.252   4.234   4.261   4.300   4.339   4.377   4.408
  4.421   4.443   4.471   4.496   4.518   4.517   4.477   4.462   4.476
  4.508   4.508   4.480   4.477   4.468   4.471   4.468   4.447   4.445
  4.447   4.422   4.382   4.345   4.347   4.340   4.347   4.340   4.341
  4.349   4.368   4.380   4.365   4.344   4.348   4.379
200
147.200  14.440  57.250    .960  56.280   7.800  31.000   1.090  28.700
147.410  14.290  56.610    .840  57.270   8.300  31.160    .830   8.300
147.630  14.200  56.510    .840  57.790   8.160  31.610   1.610  22.100
147.840  14.250  56.040    .870  60.510   8.230  32.000   4.290  95.600
201
148.910  13.980  55.750    .900  60.240   9.350  40.830   2.960  29.100
149.130  14.130  56.030    .910  60.530   9.920  40.230   4.360  42.000
149.340  14.070  56.220   1.650  63.160   9.430  36.750   3.490  37.600
149.560  14.780  58.020    .110  60.620   9.150  37.090   2.530  83.900
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511321
     36.4      63.5      88.1      12.2      99.31.2685E+048.8306E+07
     57.8      96.9      12.6      75.0 5.497E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511322
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(Continued)

Table H-1 (cont'd)

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        36.4      63.5      87.5      12.2      99.31.2673E+048.5993E+07
        57.3      96.6      11.8      75.0 4.027E+00
   PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
    511323
        36.4      63.5      87.1      12.1     100.01.2606E+048.9300E+07
        57.7      96.5       6.4      30.0 4.323E+00

     : RUNID 511361   APR 25, 1978
      5.736   5.734   5.733   5.746   5.769   5.795   5.802   5.825   5.850
      5.860   5.855   5.840   5.829   5.817   5.810   5.810   5.817   5.823
      5.811   5.756   5.718   5.700   5.691   5.690   5.687   5.679   5.665
      5.665   5.670   5.655   5.657   5.681   5.698   5.716   5.732   5.742
      5.750   5.756   5.765   5.772   5.776   5.780   5.785   5.789   5.792
      5.795   5.821   5.850   5.864   5.846   5.838   5.841
    200
     11.590  14.600  58.000   1.110  52.780   9.760  39.750   -.140 158.900
     11.800  14.410  57.120    .900  52.810   9.830  40.160   -.040  59.300
     12.020  14.310  57.240   1.080  60.300   8.620  36.240   3.520   1.000
     12.230  14.270  56.690    .960  57.630  10.240  41.760   1.850  41.100
    201
     13.090  14.410  57.490    .930  52.760  11.020  46.030   5.390 102.100
     13.300  14.670  58.260    .590  59.930  11.810  49.450   3.350  26.600
     13.520  14.660  58.170    .610  60.370  11.770  47.310   3.710  57.300
     13.730  14.410  56.730    .700  60.210  12.160  48.230   5.050  80.100
    202
     14.810  14.440  57.140    .660  58.390  13.420  53.830   3.700 156.300
     15.020  14.200  56.570    .800  59.410  13.380  53.790   4.310 176.700
     15.240  14.250  56.960    .860  56.690  12.750  56.100   1.720  51.800
     15.450  15.060  60.590    .740  55.300  13.700  55.560   2.810  65.600
    204
     16.950  14.490  56.740    .820  52.220  14.990  61.890   -.090 140.500
     17.170  14.610  58.010    .780  52.290  15.320  62.660   -.380  80.600
     17.380  14.040  58.460    .310  52.000  15.670  61.400   -.020  85.000
     17.590  14.980  57.610    .080  52.490  15.640  62.280   -.040  77.500
     : RUNID 511362   APR 25, 1978
      4.104   4.108   4.116   4.118   4.088   4.083   4.084   4.097   4.130
      4.169   4.186   4.188   4.223   4.265   4.293   4.330   4.389   4.434
      4.411   4.394   4.402   4.433   4.469   4.494   4.467   4.410   4.395
      4.424   4.447   4.426   4.417   4.448   4.496   4.514   4.483   4.493
      4.518   4.553   4.558   4.553   4.591   4.621   4.639   4.654   4.634
      4.637   4.675   4.709   4.726   4.735   4.694   4.656
    200
     28.120  14.320  56.500    .840  44.370  11.570  46.310   1.560  32.800
     28.330  14.320  56.610    .790  46.230  11.920  46.190   3.880  28.000
     28.550  14.250  56.160    .890  50.610  11.830  46.710   4.010  36.800
     28.760  14.090  55.900    .900  47.910  11.880  46.750   3.040  50.100
    201
     30.910  14.390  56.760    .980  47.570  12.860  50.340   2.770   2.000
     31.120  14.210  56.510    .980  47.520  12.730  49.600   3.680  35.100
     31.340  14.310  57.300   1.080  47.980  12.780  49.980   2.800  53.400
     31.550  14.190  56.130    .850  45.030  12.900  49.410   3.240  41.200
    202
     33.490  16.250  65.030   1.120  49.320  13.540  52.840   4.410  78.400
     33.700  16.680  65.990    .270  48.660  13.790  53.150   3.730  26.600
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(Continued)

Table H-1 (cont'd)

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 33.920  15.850  61.560   -.450  46.680  13.500  52.580   2.160  98.700
 34.130  15.400  60.570   -.110  44.630  13.640  52.670   2.490 134.900
204
 36.280  16.730  64.940   1.270  49.360  15.570  59.750   4.170 102.600
 36.500  14.370  59.290   -.080  48.390  15.050  57.860   5.160  96.900
 36.710  13.830  57.920   1.450  49.470  14.850  57.500   5.890  65.000
 36.930  16.040  62.250    .320  47.870  14.940  58.510   3.680  73.800
 : RUNID 511363   APR 25, 1978
  5.591   5.597   5.605   5.632   5.652   5.676   5.700   5.728   5.752
  5.764   5.773   5.786   5.794   5.800   5.806   5.823   5.845   5.860
  5.873   5.868   5.861   5.861   5.859   5.858   5.854   5.852   5.852
  5.876   5.892   5.884   5.850   5.829   5.833   5.865   5.867   5.832
  5.827   5.846   5.869   5.898   5.918   5.935   5.937   5.913   5.902
  5.923   5.955   5.975   5.988   5.991   5.993   6.004
200
 48.090  14.620  57.210   1.100  43.400   3.430  13.040   1.220  65.000
 48.310  14.650  57.290   1.080  44.950   3.230  12.270   2.380  82.300
 48.520  14.600  57.120   1.060  44.520   3.050  11.940   2.250  79.600
 48.740  14.610  57.380   1.080  44.540   3.100  11.650   2.400  28.800
201
 49.810  14.540  57.210    .380  48.430   3.820  14.080   3.840  34.300
 50.030  14.490  57.300    .830  47.580   3.460  13.500   5.630  73.000
 50.240  14.990  57.980    .480  47.870   3.240  12.620   3.560  46.200
 50.460  14.240  56.350    .650  44.960   3.220  12.300   3.150  42.900
202
 51.530  14.030  56.490    .310  44.390   4.250  16.160   2.890   3.000
 51.750  14.310  56.670    .590  45.180   4.130  15.290   3.530  13.100
 51.960  14.130  56.210    .740  48.120   3.770  14.540   3.900  29.900
 52.180  14.080  55.960   1.050  47.440   3.560  13.670   4.240  51.500
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511361
      36.4       63.5       82.9       19.1       97.91.9850E+041.3335E+08
      58.2       97.2       14.4       75.0 5.767E+00


  : RUNID 511371   APR 27, 1978
    .813    .816    .826    .863    .855    .883    .956   1.041   1.087
   1.117   1.120   1.109   1.091   1.070   1.050   1.032   1.029   1.048
   1.048   1.037   1.018    .995    .971    .952    .932    .912    .891
    .870    .848    .825    .793    .776    .761    .746    .742    .743
    .726    .708    .691    .672    .668    .661    .649    .636    .623
    .610    .599    .587    .575    .563    .551    .540
 200
   3.320   9.650  38.170   3.570  63.220  10.770  42.470   4.100 322.900
   3.530   9.810  38.740   3.540  62.770  10.390  44.590   4.120 327.400
   3.750   9.940  38.920   3.550  62.750  10.730  42.770   4.290 332.000
   3.960   9.890  39.050   3.550  62.320  10.260  42.620   4.150 309.300
 201
   4.820   9.920  39.250   3.540  64.980  11.680  48.300   5.750 287.600
   5.040   9.770  38.620   3.520  64.950  11.950  49.580   4.560 340.900
   5.260   9.750  38.370   3.470  63.570  11.900  48.880   5.210 311.100
   5.470   9.840  38.900   3.490  63.800  11.680  49.510   4.260 307.000
 202
   6.550   9.890  38.790   3.470  61.910  13.770  53.940   4.880 320.200
   6.760   9.830  38.830   3.510  63.480  13.340  53.900   3.730 346.800
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(Continued)

Table H-1 (cont'd)

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   6.980   9.840  38.690   3.510  62.110  13.780  54.940   4.470 321.700
   7.190   9.980  39.550   3.550  61.060  13.160  54.030   5.710 102.300
 204
   8.060  10.000  39.290   3.540  65.210  14.050  55.450   6.740 312.600
   8.270   9.920  38.990   3.540  63.420  14.200  57.170   5.300 317.400
   8.490   9.910  39.150   3.580  59.820  13.280  54.560   6.080 347.600
   8.700  10.010  39.560   3.670  67.000  12.940  54.150   7.630 357.200
  : RUNID 511372    APR 27, 1978
    .737    .751    .777    .857    .894    .945    .996   1.016   1.035
   1.054   1.079   1.101   1.096   1.080   1.058   1.036   1.011    .989
    .968    .948    .928    .908    .889    .880    .882    .372    .857
    .858    .867    .876    .928    .999   1.035   1.035   1.019    .999
    .977    .973   1.026   1.094   1.121   1.120   1.125   1.152   1.219
   1.303   1.330   1.413   1.392   1.383   1.394   1.405
 200
  20.330  10.800  43.070   4.180  59.670   6.330  26.590   3.570 336.400
  20.550  10.860  43.270   4.090  61.410   6.330  27.920   3.470 288.900
  20.770  10.600  41.800   3.850  60.650   6.550  25.490   4.550 314.300
  20.980  10.560  42.100   3.980  59.490   6.680  26.080   2.750 322.900
 201
  21.840  10.580  42.240   4.050  58.870   8.080  32.790   3.920 328.700
  22.060  10.690  42.650   4.080  60.010   7.890  31.810   2.870 344.700
  22.270  10.780  42.650   4.120  61.490   9.200  33.670   4.840 354.800
  22.490  10.690  42.340   4.120  60.410   8.360  33.400   3.500 311.500
 204
  23.570  10.470  41.970   4.130  63.140   9.660  38.990   5.480    .600
  23.780  10.560  41.490   4.030  62.480   9.170  42.380   4.190   3.300
  24.000  10.450  41.350   4.150  61.140  10.650  38.290   6.660 358.000
  24.210  10.640  41.720   4.130  62.410   9.960  42.390   5.050 307.900
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511371
      36.4       63.5       86.1        9.2       97.39.5857E+037.7000E+07
      49.7       81.1       16.2       75.0 8.409E-01

  : RUNID 511421    MAY 18, 1978
   5.152   5.154   5.155   5.138   5.120   5.114   5.125   5.138   5.146
   5.154   5.159   5.155   5.135   5.108   5.097   5.091   5.086   5.077
   5.055   5.036   5.043   5.076   5.105   5.123   5.132   5.149   5.163
   5.172   5.175   5.186   5.198   5.211   5.218   5.200   5.185   5.181
   5.185   5.194   5.204   5.216   5.227   5.240   5.255   5.263   5.266
   5.267   5.282   5.290   5.262   5.234   5.212   5.209
 200
 158.240  13.660  54.270   1.590  59.150    .710   2.860   1.440 306.700
 158.460  13.740  54.430   1.660  59.310   1.230   4.440   1.360 308.800
 158.670  13.900  55.050   1.620  59.010    .560   5.390   1.370 316.700
 158.890  13.830  54.710   1.530  58.980   1.160   3.810   1.390 313.000
 201
 159.530  13.700  54.620   1.500  59.660   3.060  12.610   1.340 322.100
 159.750  13.710  54.420   1.520  59.450   2.280  10.150   1.590 313.700
 159.960  13.670  54.510   1.500  58.380   2.690  11.960   1.210 330.200
 160.180  13.810  54.430   1.510  58.770   2.940  12.500   1.430 319.000
 202
 161.040  13.850  54.860   1.550  59.470   4.780  19.640   1.370 341.700
 161.250  13.870  54.970   1.530  59.340   4.740  19.680   1.690 332.900
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(Continued)

Table H-1 (cont'd)

```
161.470  13.780  54.940   1.520  58.870   5.000  18.870   1.500 335.100
161.680  13.820  55.030   1.440  59.130   4.760  19.300   1.570 338.300
204
162.760  14.030  55.590   1.690  59.560   7.370  30.430   1.580 339.900
162.970  13.980  55.810   1.690  59.230   7.540  30.850   1.610 332.700
163.190  13.990  55.550   1.640  59.350   7.450  30.310   1.610 346.600
163.400  14.050  55.710   1.630  59.490   7.630  30.850   1.810 340.100
 : RUNID 511422   MAY 18, 1978
  5.000   5.002   5.003   5.008   5.015   5.027   5.023   5.000   4.958
  4.933   4.931   4.945   4.943   4.940   4.924   4.906   4.893   4.884
  4.888   4.892   4.897   4.898   4.884   4.870   4.855   4.811   4.768
  4.748   4.729   4.720   4.731   4.749   4.755   4.762   4.767   4.771
  4.763   4.743   4.734   4.733   4.737   4.740   4.732   4.714   4.709
  4.715   4.729   4.745   4.758   4.758   4.757   4.758
200
173.720  15.010  59.680   1.870  57.610   3.330  13.200    .640   4.100
173.930  14.980  59.310   1.930  57.520   3.250  13.540    .670   1.200
174.150  15.020  59.290   1.890  57.150   3.470  12.790    .620 344.900
174.360  14.950  59.080   1.920  57.230   3.460  14.310    .620 347.600
201
175.230  14.590  58.420   1.970  57.290   4.660  20.450    .930 303.200
175.440  14.770  58.640   1.850  57.140   5.400  21.430    .760 318.400
175.660  14.860  59.470   1.940  57.710   5.570  21.340    .830 336.600
175.870  14.820  58.720   1.770  58.030   5.600  22.150    .920 333.500
202
176.730  14.770  58.930   1.780  57.560   6.800  28.420    .710 277.300
176.950  14.840  58.900   1.790  57.850   7.360  29.480    .890 297.400
177.160  14.900  59.260   1.880  58.390   7.100  28.490   1.320 320.700
177.380  15.000  59.380   1.850  58.290   7.360  28.620   1.250 308.700
204
178.240  14.880  59.160   1.790  58.290   9.800  39.550    .960 294.100
178.450  14.940  59.580   1.960  58.300  10.330  39.090   1.320 320.700
178.670  15.060  59.800   1.960  57.740   9.340  38.920    .760 314.400
178.880  15.040  60.170   1.930  57.550  10.150  40.080   1.070 318.400
 : RUNID 511423   MAY 18, 1978
  4.575   4.577   4.583   4.589   4.598   4.604   4.600   4.584   4.566
  4.553   4.528   4.509   4.488   4.470   4.468   4.464   4.444   4.430
  4.428   4.427   4.430   4.424   4.411   4.398   4.398   4.406   4.413
  4.417   4.412   4.423   4.428   4.395   4.355   4.322   4.300   4.288
  4.277   4.267   4.256   4.241   4.234   4.227   4.221   4.217   4.216
  4.220   4.219   4.228   4.230   4.227   4.223   4.220
200
188.340  15.650  62.150   1.970  57.520   4.530  17.290    .900 314.400
188.560  15.450  62.030   2.060  57.320   4.730  18.690    .760 298.000
188.770  15.580  62.220   2.110  57.430   4.790  18.970    .980 301.100
188.990  15.570  62.050   2.170  57.920   4.480  18.720    .990 304.100
201
189.850  15.670  62.650   2.240  57.800   5.690  25.550   1.310 316.900
190.060  15.790  62.570   2.220  57.710   6.200  25.620   1.170 333.700
190.280  15.650  62.810   2.200  57.100   6.250  24.330    .730 349.600
190.490  15.740  62.870   2.190  57.480   6.450  25.560    .950 349.600
202
191.570  15.780  62.960   2.140  57.460   8.230  30.770    .490   1.100
191.780  15.750  62.930   2.210  57.890   7.370  31.010   1.190 329.300
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(Continued)

Table H-1 (cont'd)

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 192.000  15.830  62.950   2.240  57.160   7.870  32.490    .680 346.300
 192.210  15.780  63.270   2.220  57.130   8.370  33.870    .920 353.800
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511421
     36.4      63.5      78.7      18.7      93.31.9433E+041.0711E+08
     56.7      93.7       4.6      75.0 5.168E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511422
     36.4      63.5      78.0      18.7      92.81.9511E+049.4087E+07
     58.6      92.6       2.8      75.0 4.840E+00

  : RUNID 511431   APR 28, 1978
   1.539   1.532   1.520   1.488   1.455   1.422   1.389   1.357   1.326
   1.295   1.265   1.237   1.209   1.181   1.154   1.129   1.114   1.111
   1.107   1.110   1.121   1.145   1.155   1.145   1.168   1.218   1.266
   1.305   1.332   1.335   1.317   1.291   1.262   1.234   1.205   1.178
   1.151   1.124   1.098   1.093   1.103   1.095   1.082   1.094   1.113
   1.151   1.173   1.171   1.203   1.258   1.300   1.335
 200
  22.710  14.360  57.280   5.280  67.280  12.730  52.280   3.060 330.100
  22.920  14.480  57.370   5.480  64.580  12.540  51.190   2.800 332.300
  23.140  14.530  57.350   5.590  65.250  12.580  51.820   2.710 337.000
  23.350  14.680  58.110   5.670  64.020  12.580  51.540   2.230 323.800
 201
  24.220  14.550  57.930   5.830  65.160  14.370  58.840   1.550 348.400
  24.430  14.730  58.710   5.960  62.670  14.410  58.000   2.850 293.700
  24.650  14.580  57.840   5.820  63.410  14.460  57.960   1.720  72.500
  24.860  14.510  57.530   5.800  64.420  14.380  58.730   1.060 275.500
 202
  26.160  14.430  57.260   6.200  67.190  16.060  64.680   3.150 332.800
  26.370  14.380  57.190   6.200  68.000  16.090  65.730   4.290   7.100
  26.590  14.480  57.520   6.190  66.550  16.130  64.900   3.340 335.700
  26.800  14.470  57.240   6.080  67.910  15.830  64.980   4.850 321.500
 204
  27.670  14.340  56.780   6.230  69.150  16.310  66.450   4.810 337.600
  27.880  14.350  56.710   6.180  67.980  16.410  66.880   4.470 354.600
  28.100  14.350  56.580   6.170  67.370  16.720  67.940   3.500 360.100
  28.310  14.420  57.270   6.180  68.520  16.470  66.630   5.110 322.500
  : RUNID 511432   APR 28, 1978
    .478    .480    .483    .482    .476    .486    .507    .514    .511
    .504    .495    .486    .476    .467    .459    .450    .443    .435
    .427    .420    .413    .406    .399    .392    .386    .379    .373
    .366    .361    .355    .349    .343    .338    .333    .328    .323
    .317    .312    .308    .304    .300    .296    .291    .286    .283
    .278    .273    .269    .265    .262    .259    .254
 200
  38.220  15.320  60.690   6.930  66.850  12.700  51.540   3.960 337.400
  38.440  15.260  60.720   7.080  64.710  12.750  52.400   3.000 323.800
  38.650  15.280  60.470   7.000  63.380  12.820  52.420   2.710   3.100
  38.870  15.360  60.880   7.000  65.620  12.980  52.940   4.330 350.900
 201
  39.940  15.370  60.900   6.980  64.930  14.500  59.000   3.320 346.400
  40.160  15.410  60.960   6.970  65.730  14.470  58.550   2.630 348.700
  40.370  15.610  62.260   7.100  67.420  14.290  58.050   5.150 309.600
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(Continued)

Table H-1 (cont'd)

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 40.590  15.170  60.520   6.990  68.890  14.230  58.500   5.790 327.200
204
 41.670  15.000  59.690   7.220  70.860  16.020  65.220   5.390 323.800
 41.880  15.210  60.140   7.070  68.640  16.140  65.210   4.780 340.100
 42.100  15.080  59.780   7.140  68.850  16.350  65.330   4.910 317.800
 42.310  15.040  59.660   7.050  66.850  16.290  66.410   4.570 292.900
 : RUNID 511433    APR 28, 1978
  1.125   1.131   1.151   1.228   1.292   1.328   1.361   1.359   1.380
  1.422   1.413   1.406   1.426   1.467   1.551   1.616   1.658   1.695
  1.736   1.783   1.791   1.783   1.762   1.764   1.762   1.760   1.749
  1.729   1.741   1.795   1.841   1.868   1.882   1.912   1.945   1.974
  1.981   1.979   1.973   1.945   1.907   1.880   1.859   1.831   1.802
  1.771   1.737   1.701   1.664   1.624   1.584   1.544
200
 53.290  16.110  64.050   7.430  66.240  12.960  54.320   3.530   5.300
 53.510  16.050  63.710   7.310  66.300  13.100  52.840   4.290   4.800
 53.720  15.890  63.460   7.410  65.600  12.910  52.640   4.100   2.200
 53.940  16.100  64.010   7.460  64.790  12.990  52.960   3.180  56.500
201
 54.800  16.200  64.270   7.480  64.100  14.540  59.120   3.450 313.800
 55.020  15.880  62.980   7.370  64.570  14.640  59.270   3.430 352.700
 55.230  15.960  63.200   7.460  69.370  14.560  59.640   4.700 320.900
 55.450  15.840  63.240   7.550  66.750  14.690  59.300   4.240 326.100
204
 56.310  16.000  63.400   7.570  65.250  16.300  66.490   4.440 306.100
 56.520  15.780  63.010   7.590  68.780  16.310  66.440   4.140 344.400
 56.740  16.120  63.960   7.690  66.960  16.370  66.600   3.900 352.200
 56.950  15.850  62.730   7.470  66.420  16.160  65.900   5.380 357.000
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511431
      36.4      63.5      88.0       9.2      90.79.5366E+036.0603E+07
      58.3      77.0       5.9      75.0 1.234E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511432
      36.4      63.5      88.0       9.6      91.49.9497E+032.8914E+07
      59.7      73.8      13.9      75.0 3.823E-01
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511433
      36.4      63.5      89.0       9.7      88.91.0137E+044.1583E+07
      60.9      73.5      12.4      30.0 1.661E+00

 : RUNID 511441    MAY 18, 1978
  6.340   6.341   6.342   6.346   6.310   6.267   6.241   6.221   6.216
  6.234   6.247   6.236   6.215   6.204   6.197   6.155   6.100   6.070
  6.049   6.047   6.058   6.068   6.078   6.086   6.089   6.097   6.098
  6.102   6.102   6.080   6.067   6.031   6.012   5.978   5.965   5.957
  5.956   5.962   5.982   5.978   5.952   5.941   5.955   5.980   6.002
  6.017   6.020   6.026   6.047   6.073   6.101   6.119
200
 91.600  10.920  43.140    .600  59.020    .630   5.070    .920 294.900
 91.820  10.750  42.660    .580  58.980   1.070   4.390    .930 311.500
 92.030  10.750  42.590    .570  59.410   1.190   5.230   1.070 318.900
 92.250  10.820  42.780    .630  59.390    .920   4.790   1.280 330.600
201
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(Continued)

Table H-1 (cont'd)

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   92.680  10.650  42.220    .450  60.930   2.420  11.230   1.510 301.000
   92.890  10.640  41.960    .460  59.350   2.770  12.030   1.290 317.000
   93.110  10.800  42.600    .600  59.030   2.780  10.730   1.100 319.600
   93.320  10.740  42.180    .630  59.110   2.760  11.210    .970 317.900
  202
   93.970  10.850  42.840    .700  61.300   4.660  19.650   1.740 319.800
   94.180  10.640  42.100    .590  58.540   3.930  18.820    .980 313.400
   94.400  10.700  42.060    .650  59.370   4.390  18.460    .920 313.600
   94.610  10.680  42.250    .660  59.320   4.460  18.900   1.010 300.100
  203
   95.470  11.440  45.220   1.150  60.700   7.140  29.010   1.450 315.300
   95.690  11.400  45.280   1.160  60.500   6.840  28.820   1.830 333.000
   95.900  11.430  45.310   1.070  60.860   7.180  28.280   1.920 323.100
   96.120  11.550  45.630   1.120  60.810   6.970  28.210   1.890 332.800
  204
   97.410  14.970  59.320   3.500  62.250  11.110  45.020   2.740 338.900
   97.620  15.010  59.930   3.480  61.950  11.250  45.380   2.590 343.700
   97.840  15.060  59.640   3.420  62.340  11.170  45.190   2.710 344.700
   98.050  14.990  59.690   3.380  62.640  11.080  44.980   2.940 343.600
   : RUNID 511442   MAY 18, 1978
    6.018   6.024   6.034   6.032   6.008   6.003   6.003   6.007   6.004
    5.978   5.956   5.909   5.842   5.807   5.795   5.805   5.818   5.815
    5.800   5.800   5.790   5.779   5.758   5.743   5.739   5.745   5.757
    5.783   5.788   5.792   5.780   5.736   5.712   5.698   5.693   5.665
    5.633   5.633   5.655   5.670   5.680   5.691   5.700   5.715   5.727
    5.718   5.672   5.650   5.652   5.669   5.692   5.713
  200
  107.940  11.530  45.760    .720  58.690   -.540    .670    .780 349.200
  108.160  11.480  45.130    .680  58.800    .010   -.820    .780 330.900
  108.370  11.600  45.750    .700  58.510    .210   2.200    .610 328.000
  108.590  11.590  45.870    .760  58.170   -.390   1.500    .620 332.300
  201
  109.450  11.650  45.910    .760  58.510   1.910   7.960    .900 297.500
  109.660  11.570  45.690    .690  58.720   1.940   8.300    .930 304.500
  109.880  11.550  45.550    .670  58.370   2.110   6.140    .550 296.000
  110.090  11.520  45.610    .720  58.420   1.850   8.200    .870 303.200
  202
  110.950  11.890  47.330    .980  58.460   3.610  14.430    .480 315.200
  111.170  11.790  47.090    .860  59.450   3.720  15.020    .960 289.400
  111.380  11.940  46.930    .870  58.430   3.550  15.660    .890 291.900
  111.600  11.700  46.420    .780  58.410   3.820  16.070    .600 297.200
  203
  112.670  12.190  47.830   1.140  59.080   6.440  26.280    .750 317.500
  112.890  12.080  47.630   1.040  59.470   6.510  27.610   1.080 304.000
  113.100  12.090  47.540   1.090  58.810   6.260  26.870    .850 299.300
  113.320  12.190  47.900   1.120  58.860   6.320  26.200    .840 295.400
  204
  114.180  12.510  49.570   1.340  61.040   8.710  35.370   1.750 310.600
  114.390  12.620  49.990   1.440  59.080   8.050  37.100   1.190 317.200
  114.610  12.650  49.790   1.390  59.820   8.970  36.600   1.470 311.700
  114.820  12.720  50.190   1.500  59.300   8.960  36.550   1.210 312.600
   : RUNID 511443   MAY 18, 1978
    3.156   3.164   3.181   3.214   3.187   3.148   3.132   3.099   3.066
    3.040   3.001   2.967   2.947   2.969   3.013   3.053   3.077   3.088
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(Continued)

Table H-1 (cont'd)

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  3.111   3.116   3.112   3.075   3.040   3.012   2.975   2.926   2.875
  2.846   2.824   2.820   2.828   2.841   2.851   2.860   2.885   2.900
  2.909   2.883   2.881   2.866   2.853   2.822   2.781   2.738   2.700
  2.703   2.766   2.839   2.878   2.916   2.909   2.865
 200
 124.930  12.140  48.210    .970  60.640    .310   1.230   2.060 295.300
 125.140  12.010  47.730    .880  60.940   -.040    .130   2.020 314.300
 125.360  11.960  47.050    .890  60.580       0    .590   1.890 302.700
 125.570  11.960  47.420    .920  60.130    .050   2.280   1.580 308.700
 201
 126.650  12.310  48.840   1.190  59.660   2.090   8.840   1.290 284.900
 126.860  12.230  48.190   1.040  59.390   1.930   8.940   1.200 300.100
 127.080  12.290  48.600   1.140  59.380   2.290   7.400   1.620 298.200
 127.290  11.960  47.800    .940  59.550   2.250   6.360   1.260 289.600
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511441
     36.4       63.5      84.3       12.8       94.71.3341E+048.2563E+07
     51.3       97.3       4.0       75.0 6.103E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511442
     36.4       63.5      84.1       13.2       94.91.3706E+047.7235E+07
     52.8       96.6       2.7       75.0 5.794E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511443
     36.4       63.5      83.0       12.7       94.91.3197E+047.9174E+07
     53.6       95.7       6.2       30.0 2.956E+00

  : RUNID 511481   MAY 18, 1978
  6.336   6.337   6.338   6.342   6.341   6.333   6.323   6.314   6.306
  6.295   6.285   6.279   6.272   6.270   6.279   6.283   6.285   6.289
  6.297   6.296   6.290   6.278   6.233   6.196   6.185   6.185   6.189
  6.206   6.228   6.235   6.232   6.226   6.221   6.218   6.216   6.213
  6.212   6.221   6.226   6.224   6.208   6.199   6.204   6.204   6.198
  6.189   6.184   6.179   6.174   6.168   6.164   6.162
 200
  28.810   8.250  32.350    .140  58.630   3.050  13.840    .180 327.600
  29.020   8.340  32.450    .190  58.640   3.070  13.010    .410 330.600
  29.240   8.250  33.030    .190  59.260   2.430  10.690    .650 328.300
  29.450   8.220  32.620    .140  59.380   3.130  11.440    .610 327.700
 201
  30.310   8.640  33.920    .280  59.550   3.710  16.990    .850 343.700
  30.530   8.810  34.690    .340  59.610   3.820  16.090   1.000 336.400
  30.740   8.800  34.730    .340  59.790   3.310  14.570   1.060 332.100
  30.960   8.830  34.850    .330  60.040   3.720  16.440   1.170 329.900
 202
  31.820   9.580  37.710    .590  60.530   4.650  19.040   1.140   1.700
  32.030   9.560  37.910    .490  60.640   4.980  20.650   1.420 348.900
  32.250   9.640  37.660    .460  60.550   5.130  19.770   1.440 350.600
  32.460   9.590  37.550    .370  60.730   4.890  20.130   1.490 346.800
 203
  33.320  10.960  43.820    .960  61.140   7.130  29.390   1.550 354.300
  33.540  11.180  44.070    .900  61.490   7.070  28.060   1.980 359.500
  33.750  11.240  43.990    .840  61.390   6.910  28.370   1.780 359.900
  33.970  11.130  44.270    .830  61.290   6.940  27.350   1.810  31.600
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(Continued)

Table H-1 (cont'd)

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204
 35.470  14.810  59.100   3.440  61.910  13.920  55.560   2.080 342.400
 35.690  14.870  58.980   3.300  60.640  13.460  56.150   1.290 322.100
 35.900  14.840  59.110   3.290  60.320  14.390  59.720   1.100   2.000
 36.120  14.780  59.060   3.240  59.620  14.700  58.410    .530  40.900
 : RUNID 511482   MAY 18, 1978
  6.371   6.372   6.375   6.374   6.373   6.366   6.342   6.321   6.306
  6.301   6.294   6.286   6.285   6.303   6.315   6.324   6.331   6.331
  6.327   6.327   6.300   6.274   6.256   6.211   6.182   6.166   6.152
  6.147   6.161   6.160   6.158   6.153   6.142   6.135   6.138   6.150
  6.161   6.168   6.173   6.172   6.169   6.170   6.172   6.162   6.147
  6.138   6.129   6.125   6.129   6.130   6.127   6.127
200
 46.230   8.810  34.600    .210  60.290  -1.050  -7.080   1.340 335.900
 46.440   8.720  34.170    .150  60.110  -1.760  -4.280   1.210 342.400
 46.660   8.720  34.240    .180  60.210  -1.750  -4.370   1.210 354.900
 46.870   8.600  34.160    .170  60.320  -1.160  -4.180   1.390 359.900
201
 47.730   9.760  38.520    .620  60.600    .090   1.130   1.650 341.200
 47.950   9.900  38.810    .600  60.520    .360   2.290   1.570 346.100
 48.160   9.840  39.110    .560  60.780    .260   -.080   1.530 343.000
 48.380   9.760  38.890    .540  60.660    .460   2.660   1.570 343.300
202
 49.240  10.240  40.350    .620  62.200   2.580  10.110   1.840 348.500
 49.450  10.340  40.220    .580  61.460   2.430  11.140   2.090 342.600
 49.670  10.260  40.250    .570  61.370   2.430  11.500   1.910 343.300
 49.880  10.230  40.220    .500  61.400   2.620  11.190   1.840 341.600
203
 50.960  11.330  44.960   1.150  63.650   5.520  22.540   3.280 359.100
 51.170  11.520  45.570   1.220  63.730   5.540  22.970   3.290 359.900
 51.390  11.600  45.820   1.180  63.410   5.540  23.260   3.200 359.500
 51.600  11.580  45.860   1.180  63.360   5.620  23.460   3.090 359.900
204
 52.900  13.460  53.660   2.290  63.760   8.560  34.900   3.390 354.400
 53.110  13.530  53.940   2.280  63.660   8.570  34.910   3.290 355.900
 53.330  13.570  53.930   2.290  63.680   7.990  33.520   3.330 356.700
 53.540  13.620  54.220   2.280  63.560   8.730  35.710   3.200 355.300
 : RUNID 511483   MAY 18, 1978
  5.829   5.830   5.825   5.806   5.790   5.778   5.746   5.742   5.746
  5.756   5.776   5.791   5.780   5.776   5.777   5.786   5.816   5.831
  5.845   5.855   5.862   5.866   5.846   5.848   5.841   5.810   5.759
  5.717   5.681   5.682   5.694   5.719   5.748   5.750   5.741   5.736
  5.722   5.705   5.683   5.688   5.661   5.634   5.631   5.633   5.630
  5.633   5.629   5.605   5.582   5.574   5.575   5.567
200
 63.430   9.460  37.350    .150  59.480    .840   2.920    .870 290.200
 63.650   9.260  36.920    .150  59.400    .480   3.950    .940 277.600
 63.860   9.280  36.810    .100  59.930   1.170   3.640   1.170 293.200
 64.080   9.310  36.670    .130  59.580    .520   2.990   1.090 285.800
201
 64.940   9.620  38.410    .300  58.930   2.230   8.410    .580 333.900
 65.150   9.670  38.220    .320  58.640   2.290  10.580    .460 325.000
 65.370   9.800  38.400    .270  58.520   1.610   7.580    .350 329.500
 65.580   9.740  38.330    .200  58.430   1.960   7.960    .470 332.900
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(Continued)

Table H-1 (cont'd)

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 202
  66.440   9.760  38.860    .380  60.510   3.900  18.580    .930 331.700
  66.660   9.870  39.140    .420  60.060   4.320  14.730   1.380 333.700
  66.870  10.000  39.310    .450  59.170   4.320  17.650    .900 319.800
  67.090   9.910  39.440    .430  59.360   3.740  15.850    .770 316.400
 203
  67.950  10.780  42.430    .860  61.190   6.920  28.560   1.630 341.000
  68.160  10.850  43.090    .880  61.260   6.090  25.580   2.280 342.800
  68.380  10.880  42.870    .730  61.050   6.590  26.280   1.880 330.700
  68.590  10.650  42.310    .660  60.820   6.980  27.910   1.860 337.600
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511481
      36.4      63.5      75.8      19.1      92.61.9900E+041.0164E+08
      47.8      98.1       3.3      75.0 6.246E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511482
      36.4      63.5      77.3      19.4      93.12.0193E+041.1166E+08
      49.7      96.8       5.2      75.0 6.229E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511483
      36.4      63.5      78.6      18.9      92.81.9655E+041.1077E+08
      48.8      99.3       3.3      30.0 5.737E+00
  : RUNID 511011   MAR 23, 1978
   3.615   3.615   3.614   3.615   3.618   3.620   3.624   3.630   3.630
   3.630   3.631   3.634   3.634   3.636   3.638   3.640   3.639   3.637
   3.637   3.637   3.639   3.642   3.640   3.639   3.639   3.639   3.639
   3.642   3.651   3.660   3.664   3.664   3.662   3.660   3.661   3.662
   3.666   3.670   3.671   3.671   3.671   3.672   3.672   3.667   3.662
   3.658   3.655   3.653   3.653   3.653   3.651   3.647
 200
  33.640   2.690  11.040    .380  85.440  -7.860  25.990    .940 301.900
  33.850   2.650  10.610    .400  85.250       0  26.190   1.040 293.500
  34.070   2.960  11.320    .370  85.680       0  27.840    .860 301.100
  34.290   3.070  10.580    .440  85.610       0  28.800    .740 292.900
 201
  35.360   3.500  13.850    .910  85.210  -8.980  24.310    .980 287.600
  35.580   3.670  14.300   1.010  85.530  -9.070  26.300    .700 299.600
  35.790   3.650  13.940    .790  85.290  -6.880  24.940    .730 294.000
  36.010   3.640  14.550    .900  85.260  -8.320  -8.660    .780 287.400
 202
  37.090   4.190  17.320   1.200  85.460  -6.860  -8.550    .660 338.300
  37.300   4.670  17.450   1.260  85.440  -4.650       0    .610 330.300
  37.520   4.560  17.550   1.230  85.550  -4.190       0    .800 331.400
  37.730   4.360  16.720   1.180  85.360  -5.770       0    .740 336.200
 203
  39.030   5.230  20.200   1.910  85.250  -2.950  -6.560   1.890 342.500
  39.240   5.400  20.150   1.690  85.430  -2.550  -8.470   1.870 343.900
  39.460   4.970  19.150   1.650  85.330  -2.280       0   1.680 336.500
  39.670   4.940  18.610   1.470  85.460  -2.570       0   1.580 341.200
 204
  40.970   7.960  31.280   3.690  85.190   2.270   3.280   2.740 339.800
  41.180   8.200  32.620   3.760  85.050   1.490   2.920   2.840 342.800
  41.400   8.260  32.800   3.840  85.140    .780   3.480   2.790 341.800
  41.610   8.010  31.850   3.400  85.060    .890   7.440   2.730 341.600
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(Continued)

Table H-1 (cont'd)

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 : RUNID 511012   MAR 23, 1978
  3.716   3.716   3.717   3.715   3.712   3.708   3.707   3.704   3.698
  3.697   3.695   3.693   3.689   3.686   3.684   3.683   3.683   3.683
  3.681   3.681   3.680   3.682   3.685   3.689   3.693   3.704   3.712
  3.717   3.722   3.728   3.730   3.729   3.726   3.722   3.719   3.720
  3.721   3.720   3.721   3.724   3.724   3.726   3.727   3.726   3.723
  3.720   3.718   3.719   3.718   3.714   3.713   3.717
200
 55.830   4.250  16.900   1.030  84.880  -7.100    .120    .200 284.700
 56.050   4.360  17.070    .900  84.770  -7.740  26.060    .310 284.500
 56.260   4.840  18.010   1.000  85.170  -8.640       0    .300 279.700
 56.480   4.470  17.350    .860  84.900  -4.080  20.210    .150 284.400
201
 57.770   5.440  21.040   1.440  85.080  -7.080    .070    .680 292.600
 57.990   5.470  21.340   1.460  85.150  -2.650       0    .270 321.800
 58.200   5.240  20.990   1.390  84.750  -6.070       0    .200 268.700
 58.420   5.360  21.510   1.580  84.810  -6.660       0    .780 308.100
202
 59.280   6.280  24.660   1.910  85.090  -1.960       0    .850 351.000
 59.490   6.130  24.050   1.800  84.930    .680       0    .730 344.800
 59.710   6.370  24.680   1.850  85.020    .370  -6.590    .570 353.300
 59.920   6.050  24.490   1.780  84.710  -1.740  -8.580    .450    .400
203
 61.000   6.420  24.300   1.930  85.030   1.800  14.180   1.000 347.500
 61.220   6.100  24.890   1.920  84.970   2.830   3.700    .950 339.500
 61.430   6.320  24.100   1.840  84.960    .080   7.460    .820 330.800
 61.650   6.390  24.960   1.880  84.860   2.160   1.360   1.020 346.300
204
 64.450   9.290  36.670   4.100  84.870   5.930  26.620   2.480 347.900
 64.660   9.340  37.010   4.280  84.760   5.530  26.090   2.640 351.800
 64.880   9.450  37.430   4.330  84.970   6.040  26.180   2.300 352.400
 65.090   9.520  38.340   4.440  84.580   5.990  33.040   2.370 358.600
 : RUNID 511013   MAR 23, 1978
  5.243   5.245   5.247   5.255   5.259   5.261   5.267   5.271   5.276
  5.280   5.282   5.283   5.283   5.277   5.271   5.268   5.269   5.272
  5.273   5.273   5.275   5.280   5.287   5.295   5.301   5.301   5.299
  5.297   5.294   5.293   5.294   5.292   5.288   5.289   5.289   5.291
  5.292   5.289   5.282   5.279   5.276   5.279   5.283   5.283   5.280
  5.279   5.282   5.288   5.293   5.293   5.291   5.291
200
 75.210   6.220  24.020   1.660  85.040  -2.580       0    .280 296.300
 75.430   6.230  24.810   1.740  84.670  -2.000   1.670    .260 302.900
 75.650   6.250  25.040   1.690  84.630  -2.410  -2.790    .140 297.500
 75.860   6.300  24.840   1.490  84.910   -.530  -4.440    .150 283.900
201
 77.150   6.690  26.460   1.840  84.880    .370   3.900    .530 306.200
 77.370   6.960  26.430   1.820  85.200   1.740  -1.510    .460 288.900
 77.580   6.880  26.290   1.900  84.890   -.370  -1.560    .720 275.700
 77.800   6.830  26.570   1.810  84.990   1.760  -2.150    .590 283.100
202
 78.660   7.150  27.800   1.860  84.800   2.400   4.380    .520 348.100
 78.880   7.160  28.060   1.910  84.960   4.480   7.180    .390 345.300
 79.090   7.330  28.220   1.940  84.880   2.780   7.150    .500 357.000
 79.310   7.130  28.590   1.880  85.050   1.960   9.970    .560 343.700
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(Continued)

Table H-1 (cont'd)

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PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511011
      36.4      63.5      73.1       9.0     100.09.3812E+033.1496E+07
      38.5      92.5       2.6      75.0 3.646E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511012
      36.4      63.5      73.7       8.4     100.08.7847E+033.0922E+07
      41.7      89.2       1.6      75.0 3.708E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511013
      36.4      63.5      74.5       8.5     100.08.8741E+033.0913E+07
      43.2      88.6        .7      30.0 5.280E+00
  : RUNID 511251   MAR 30, 1978
    .700     .701     .704     .712     .715     .719     .727     .736     .743
    .747     .753     .759     .761     .763     .760     .761     .766     .772
    .778     .783     .783     .778     .769     .759     .755     .752     .744
    .736     .730     .732     .738     .746     .746     .737     .724     .717
    .710     .698     .687     .687     .691     .692     .687     .686     .691
    .699     .707     .711     .713     .714     .720     .729
 200
  52.770  12.130  48.160   5.290  61.100  11.980  50.470   1.400 299.000
  52.980  12.270  48.250   5.240  61.040  11.770  45.650    .990 321.100
  53.200  12.240  48.600   5.360  61.130  11.510  51.510    .850 315.200
  53.410  12.240  48.240   5.310  60.920  12.060  51.760    .890 301.400
 201
  55.140  11.840  47.080   5.270  61.320  13.890  54.000    .920 287.500
  55.350  11.950  47.340   5.340  60.460  13.040  54.120    .700 296.500
  55.570  11.950  47.330   5.330  60.830  13.010  55.400   1.190 289.800
  55.780  11.890  46.980   5.270  60.430  12.970  52.930    .880 324.300
 203
  57.290  12.360  49.140   5.610  61.340  14.700  58.620   1.480 356.800
  57.510  12.360  49.120   5.640  60.620  15.400  62.560   1.000   6.600
  57.720  12.560  49.720   5.690  61.850  15.420  61.750   1.560 350.400
  57.940  12.440  49.190   5.660  62.490  14.630  64.510   1.370  15.500
 204
  59.450  12.810  50.600   5.910  61.700  16.320  68.430   1.820 331.000
  59.660  12.080  47.880   5.390  61.310  16.520  67.880   1.030 326.900
  59.880  12.090  47.650   5.320  61.990  16.650  67.920   1.420 327.100
  60.090  12.150  47.970   5.400  61.300  16.000  68.040   1.410 319.200
  : RUNID 511252   MAR 30, 1978
    .120     .120     .120     .123     .129     .138     .145     .146     .143
    .138     .133     .128     .123     .118     .113     .108     .104     .099
    .095     .090     .086     .082     .078     .074     .070     .067     .063
    .059     .056     .052     .049     .046     .042     .039     .037     .033
    .031     .027     .025     .023     .020     .017     .015     .012     .010
    .008     .006     .004     .003     .001    -.001    -.004
 200
  71.100  12.880  50.890   6.310  62.340  13.480  55.490   1.950  27.000
  71.310  12.960  51.280   6.310  62.540  13.040  52.220   1.800   4.200
  71.530  12.950  51.090   6.260  62.600  13.270  54.820   1.810  30.200
  71.750  12.970  51.390   6.340  62.840  13.600  52.730   1.610   9.200
 201
  73.040  12.880  50.750   6.440  61.380  15.010  59.390    .950    .600
  73.250  12.840  50.780   6.410  61.890  15.090  60.680   1.500  16.900
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(Continued)

Table H-1 (cont'd)

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  73.470  12.790  50.570   6.340  61.520  15.200  61.550   1.520  20.000
  73.680  12.760  50.400   6.300  61.560  15.060  61.690   1.450  11.600
 202
  75.840  12.920  50.850   6.310  61.060  16.890  66.690   1.360   2.100
  76.050  12.640  50.000   6.190  61.180  16.640  67.860   1.430  34.500
  76.270  12.820  50.760   6.340  61.280  16.800  68.400    .960  50.400
  76.490  12.810  50.500   6.230  61.250  16.570  68.300   1.840  21.400
 204
  79.720  12.420  49.180   6.190  60.780  16.530  70.210    .990 314.200
  79.940  12.550  49.580   6.210  60.520  16.600  69.190    .970 345.200
  80.150  12.610  49.830   6.190  61.760  17.160  68.050   1.410 319.400
  80.370  12.560  49.700   6.150  60.490  17.190  68.560   1.020 330.300
  : RUNID 511253   MAR 30, 1978
    .573    .573    .573    .571    .564    .552    .539    .528    .515
    .503    .492    .482    .471    .459    .447    .438    .429    .424
    .426    .430    .427    .420    .411    .408    .401    .910    .380
    .369    .358    .349    .343    .339    .338    .335    .330    .324
    .317    .308    .298    .290    .283    .277    .272    .267    .265
    .270    .275    .281    .290    .301    .310    .314
 200
  94.810  13.370  52.870   6.830  62.510  11.060  50.450   1.830 358.900
  95.030  13.420  53.150   6.800  61.190  11.250  48.500   1.010 351.100
  95.240  13.440  53.270   6.750  61.420  11.460  44.650   1.650 333.000
  95.460  13.340  52.810   6.750  61.760  11.810  47.370   1.620 314.900
 201
  96.750  13.270  52.420   6.690  63.100  13.990  55.760   2.010   9.400
  96.970  13.260  52.400   6.720  62.210  13.410  57.020   2.120  20.800
  97.180  13.260  52.390   6.680  63.090  14.150  56.890   2.430  11.400
  97.400  13.190  52.340   6.690  63.820  13.320  56.140   2.770  13.100
 202
  98.690  13.440  53.270   6.510  63.210  15.200  64.910   2.850  45.400
  98.900  13.320  52.880   6.660  65.530  15.450  63.260   3.260  13.300
  99.120  13.160  52.160   6.610  63.200  15.390  62.210   2.310  10.900
  99.340  13.230  52.500   6.720  62.560  15.410  66.430   2.080  23.400
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511251
      36.4       63.5       78.6        7.9       96.38.2146E+033.2486E+07
      53.4       74.9        3.0       75.0 7.313E-01
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511252
      36.4       63.5       79.0        7.8       95.68.1432E+033.2253E+07
      55.1       71.6        4.4       75.0 6.852E-02
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511253
      36.4       63.5       80.5        7.7       94.38.0142E+033.9168E+07
      56.1       70.9        5.0       30.0 4.048E-01
  : RUNID 511311   APR 25, 1978
   4.329   4.328   4.321   4.302   4.311   4.299   4.250   4.222   4.236
   4.252   4.275   4.313   4.348   4.362   4.392   4.425   4.454   4.435
   4.393   4.380   4.381   4.384   4.417   4.446   4.442   4.458   4.487
   4.510   4.505   4.481   4.472   4.462   4.474   4.510   4.533   4.530
   4.522   4.489   4.479   4.454   4.442   4.415   4.411   4.376   4.354
   4.370   4.400   4.438   4.476   4.440   4.378   4.319
 200
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(Continued)

Table H-1 (cont'd)

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 39.870  14.110  56.340    .590  61.600   7.620  29.650   2.150  22.200
 40.090  14.130  56.300    .630  60.870   7.260  29.420   1.960   3.200
 40.300  14.170  56.410    .630  60.780   7.640  29.910   1.510  23.700
 40.520  14.290  56.690    .570  60.520   7.350  29.500   1.450  21.200
201
 41.370  14.030  55.810    .680  61.800   9.060  36.700   2.700  30.300
 41.590  13.970  55.750    .690  61.700   8.720  35.440   2.730  47.800
 41.800  13.960  55.560    .670  63.410   8.410  35.900   4.170  15.400
 42.010  13.960  55.520    .710  63.070   9.150  37.020   2.710  49.000
202
 42.870  15.290  60.740    .930  63.350  10.260  43.390   3.590  41.800
 43.090  13.950  55.450    .270  63.940   9.990  41.760   3.000  21.100
 43.300  13.930  55.130    .610  65.160  10.360  43.530   3.840  66.200
 43.510  13.820  54.970    .690  63.080  10.220  44.820   3.740  30.900
204
 44.800  13.700  54.590    .780  64.040  12.940  53.050   3.840  83.200
 45.010  13.760  54.480    .800  62.500  12.960  53.850   3.110  38.800
 45.230  14.070  59.370    .750  63.820  13.250  54.830   2.940  52.800
 45.440  13.740  54.520    .340  63.820  12.980  53.520   3.390  95.900
 : RUNID 511312   APR 25, 1978
  3.802   3.799   3.795   3.807   3.846   3.890   3.935   3.966   3.960
  3.957   3.985   4.028   4.054   4.048   3.977   3.886   3.859   3.845
  3.827   3.796   3.790   3.822   3.871   3.925   3.978   4.041   4.096
  4.105   4.102   4.126   4.175   4.202   4.230   4.218   4.219   4.234
  4.254   4.249   4.218   4.169   4.157   4.145   4.102   4.036   3.961
  3.933   3.967   3.978   3.942   3.911   3.916   3.939
200
 56.580  14.160  56.550    .750  58.160   7.890  30.850    .560    .600
 56.790  14.180  56.330    .680  60.180   7.520  32.670   1.230   3.900
 57.010  14.090  56.220    .700  58.740   7.350  30.310   1.100 360.100
 57.220  14.410  56.670    .660  59.630   7.550  31.370    .970   5.200
201
 58.080  14.040  55.680    .710  60.760   9.900  39.020   2.500  70.400
 58.290  14.050  55.600    .690  60.810   9.880  38.730   2.050  47.700
 58.510  14.020  55.740    .660  60.210   9.820  38.970   2.070  29.400
 58.720  14.010  55.840    .640  59.790   9.350  39.030   2.210  59.900
202
 59.790  14.690  58.230   -.330  62.460  11.400  45.410   3.720  38.200
 60.010  13.940  55.370   -.330  59.830  11.750  46.160   1.090  56.100
 60.220  13.970  56.020    .310  59.570  11.200  46.770   2.020  28.200
 60.430  13.880  54.940    .310  61.270  11.820  47.420   1.930  41.100
203
 61.720  14.480  57.980    .160  61.820  14.590  56.050   2.320 115.300
 61.930  16.890  65.530    .550  62.280  14.180  54.570   3.170  64.700
 62.150  16.270  59.060   -.810  62.400  14.070  55.620   3.930  56.700
 62.360  16.500  62.040  -1.110  62.670  13.330  56.980   3.020  63.300
204
 63.220  13.520  53.590    .410  64.710  15.570  63.890   4.110  61.600
 63.430  13.430  53.590    .440  63.380  15.250  62.050   4.000  63.900
 63.650  13.440  53.500    .440  62.950  15.690  63.160   3.720  28.900
 63.860  13.450  53.510    .420  63.700  15.130  61.650   3.460  93.600
 : RUNID 511313   APR 25, 1978
   .988    .984    .979    .965    .965    .969    .963    .953    .941
   .929    .915    .903    .892    .881    .870    .857    .844    .842
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(Continued)

Table H-1 (cont'd)

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   .837    .829    .821    .813    .806    .797    .788    .780    .771
   .778    .800    .853    .895    .975   1.069   1.120   1.156   1.166
  1.158   1.142   1.124   1.108   1.089   1.072   1.074   1.117   1.139
  1.137   1.120   1.137   1.203   1.264   1.283   1.276
 200
  74.360  14.440  57.690    .900  61.610   7.540  32.080   1.740  90.200
  74.570  14.450  57.690    .860  66.200   7.530  33.250   2.550  11.800
  74.790  14.380  57.280    .850  59.600   7.310  29.660   2.580  41.100
  75.000  14.300  57.130    .860  61.590   8.340  32.560   2.710 115.400
 201
  76.070  14.160  56.600    .760  60.200   8.740  37.510   2.950 137.600
  76.290  14.180  56.750    .900  60.290   9.010  38.090   1.890 139.900
  76.500  14.630  58.980    .910  60.860   9.220  38.300   2.140  28.800
  76.710  14.330  56.700    .630  61.460   9.420  37.690   2.380 128.800
 202
  77.570  14.490  57.810   1.060  61.870  10.130  39.760   5.040  38.100
  77.790  14.980  57.780   -.500  62.450  10.850  43.990   4.560   8.700
  78.000  14.060  56.510    .490  62.580  10.540  43.200   2.980  36.800
  78.210  15.490  62.600   1.420  60.910  10.040  41.320   5.400  75.800
 204
  79.500  13.540  53.900    .510  65.420  13.050  52.600   5.400  95.100
  79.710  15.680  61.200   -.010  63.400  12.740  52.620   5.420  59.200
  79.930  14.740  61.170    .850  65.290  13.430  53.580   3.630  69.400
  80.140  14.630  56.560   -.520  63.400  13.840  55.090   3.750  83.000
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511311
     36.4      63.5      91.2       8.5     100.08.8596E+035.2071E+07
     57.2      97.2      10.1      75.0 4.402E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511312
     36.4      63.5      91.2       8.7      99.99.1053E+035.3502E+07
     57.3      97.2       7.2      75.0 4.001E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511313
     36.4      63.5      91.2       8.5     100.08.8647E+035.9054E+07
     57.9      96.5       7.9      30.0 9.834E-01
 : RUNID 511371   APR 27, 1978
   .813    .816    .826    .863    .855    .883    .956   1.041   1.087
  1.117   1.120   1.109   1.091   1.070   1.050   1.032   1.029   1.048
  1.048   1.037   1.018    .995    .971    .952    .932    .912    .891
   .870    .848    .825    .793    .776    .761    .746    .742    .743
   .726    .708    .691    .672    .668    .661    .649    .636    .623
   .610    .599    .587    .575    .563    .551    .540
 200
   3.320   9.650  38.170   3.570  63.220  10.770  42.470   4.100 322.900
   3.530   9.810  38.740   3.540  62.770  10.390  44.590   4.120 327.400
   3.750   9.940  38.920   3.550  62.750  10.730  42.770   4.290 332.000
   3.960   9.890  39.050   3.550  62.320  10.260  42.620   4.150 309.300
 201
   4.820   9.920  39.250   3.540  64.980  11.680  48.300   5.750 287.600
   5.040   9.770  38.620   3.520  64.950  11.950  49.580   4.560 340.900
   5.260   9.750  38.370   3.470  63.570  11.900  48.880   5.210 311.100
   5.470   9.840  38.900   3.490  63.800  11.680  49.510   4.260 307.000
 202
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(Continued)

Table H-1 (cont'd)

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   6.550   9.890  38.790   3.470  61.910  13.770  53.940   4.880 320.200
   6.760   9.830  38.830   3.510  63.480  13.340  53.900   3.730 346.800
   6.980   9.840  38.690   3.510  62.110  13.780  54.940   4.470 321.700
   7.190   9.980  39.550   3.550  61.060  13.160  54.030   5.710 102.300
  204
   8.060  10.000  39.290   3.540  65.210  14.050  55.450   6.740 312.600
   8.270   9.920  38.990   3.540  63.420  14.200  57.170   5.300 317.400
   8.490   9.910  39.150   3.580  59.820  13.280  54.560   6.080 347.600
   8.700  10.010  39.560   3.670  67.000  12.940  54.150   7.630 357.200
  : RUNID 511372   APR 27, 1978
    .737    .751    .777    .857    .894    .945    .996   1.016   1.035
   1.054   1.079   1.101   1.096   1.080   1.058   1.036   1.011    .989
    .968    .948    .928    .908    .889    .880    .882    .872    .857
    .858    .867    .876    .928    .999   1.035   1.035   1.019    .999
    .977    .973   1.026   1.094   1.121   1.120   1.125   1.152   1.219
   1.303   1.380   1.413   1.392   1.383   1.394   1.405
  200
   20.330  10.800  43.070   4.180  59.670   6.330  26.590   3.570 336.400
   20.550  10.860  43.270   4.090  61.410   6.330  27.920   3.470 288.900
   20.770  10.600  41.800   3.850  60.650   6.550  25.490   4.550 314.300
   20.980  10.560  42.100   3.980  59.490   6.680  26.080   2.750 322.900
  201
   21.840  10.580  42.240   4.050  58.870   8.080  32.790   3.920 328.700
   22.060  10.690  42.650   4.080  60.010   7.890  31.810   2.870 344.700
   22.270  10.780  42.650   4.120  61.490   9.200  33.670   4.840 354.800
   22.490  10.690  42.340   4.120  60.410   8.360  33.400   3.500 311.500
  204
   23.570  10.470  41.970   4.130  63.140   9.660  38.990   5.480    .600
   23.780  10.560  41.490   4.030  62.480   9.170  42.380   4.190   3.300
   24.000  10.450  41.350   4.150  61.140  10.650  38.290   6.660 358.000
   24.210  10.640  41.720   4.130  62.410   9.960  42.390   5.050 307.900
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511371
      36.4       63.5       86.1        9.2      97.39.5857E+037.7000E+07
      49.7       81.1       16.2       75.0 8.409E-01
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511372
      36.4       63.5       87.1        9.3      95.69.6640E+034.9317E+07
      51.3       79.6       11.8       30.0 1.033E+00
  : RUNID 511361   APR 25, 1978
   5.736   5.734   5.733   5.746   5.769   5.795   5.802   5.825   5.850
   5.860   5.855   5.840   5.829   5.817   5.810   5.810   5.817   5.823
   5.811   5.756   5.718   5.700   5.691   5.690   5.687   5.679   5.665
   5.665   5.670   5.655   5.657   5.681   5.698   5.716   5.732   5.742
   5.750   5.756   5.765   5.772   5.776   5.780   5.785   5.789   5.792
   5.795   5.821   5.850   5.864   5.846   5.838   5.841
  200
   11.590  14.600  58.000   1.110  52.780   9.760  39.750   -.140 158.900
   11.800  14.410  57.120    .900  52.810   9.830  40.160   -.040  59.300
   12.020  14.310  57.240   1.080  60.300   8.620  36.240   3.520   1.000
   12.230  14.270  56.690    .960  57.630  10.240  41.760   1.850  41.100
  201
   13.090  14.410  57.490    .930  52.760  11.020  46.030   5.390 102.100
   13.300  14.670  58.260    .590  59.930  11.810  49.450   3.350  26.600
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(Continued)

Table H-1 (cont'd)

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 13.520  14.660  58.170    .610  60.370  11.770  47.310   3.710  57.300
 13.730  14.410  56.730    .700  60.210  12.160  48.230   5.050  80.100
202
 14.810  14.440  57.140    .660  58.390  13.420  53.830   3.700 156.300
 15.020  14.200  56.570    .800  59.410  13.380  53.790   4.310 176.700
 15.240  14.250  56.960    .860  56.690  12.750  56.100   1.720  51.800
 15.450  15.060  60.590    .740  55.300  13.700  55.560   2.310  65.600
204
 16.950  14.490  56.740    .820  52.220  14.990  61.890   -.090 140.500
 17.170  14.610  58.010    .780  52.290  15.320  62.660   -.380  80.600
 17.380  14.040  58.460    .310  52.000  15.670  61.400   -.020  85.000
 17.590  14.980  57.610    .080  52.490  15.640  62.280   -.040  77.500
 : RUNID 511362   APR 25, 1978
  4.104    4.108    4.116    4.118    4.088    4.083    4.084    4.097    4.130
  4.169    4.186    4.188    4.223    4.265    4.293    4.330    4.389    4.434
  4.411    4.394    4.402    4.433    4.469    4.494    4.467    4.410    4.395
  4.424    4.447    4.426    4.417    4.448    4.496    4.514    4.483    4.493
  4.518    4.553    4.558    4.553    4.591    4.621    4.639    4.654    4.634
  4.637    4.675    4.709    4.726    4.735    4.694    4.656
200
 28.120  14.320  56.500    .840  44.370  11.570  46.310   1.560  32.800
 28.330  14.320  56.610    .790  46.230  11.920  46.190   3.880  28.000
 28.550  14.250  56.160    .890  50.610  11.830  46.710   4.010  36.800
 28.760  14.090  55.900    .900  47.910  11.880  46.750   3.040  50.100
201
 30.910  14.390  56.760    .980  47.570  12.860  50.340   2.770   2.000
 31.120  14.210  56.510    .980  47.520  12.730  49.600   3.680  35.100
 31.340  14.310  57.300   1.080  47.980  12.780  49.980   2.800  53.400
 31.550  14.190  56.130    .850  45.030  12.900  49.410   3.240  41.200
202
 33.490  16.250  65.030   1.120  49.320  13.540  52.840   4.410  78.400
 33.700  16.680  65.990    .270  48.660  13.790  53.150   3.730  26.600
 33.920  15.850  61.560   -.450  46.680  13.500  52.580   2.160  98.700
 34.130  15.400  60.570   -.110  44.630  13.640  52.670   2.490 134.900
204
 36.280  16.730  64.940   1.270  49.360  15.570  59.750   4.170 102.600
 36.500  14.370  59.290   -.080  48.390  15.050  57.860   5.160  96.900
 36.710  13.830  57.920   1.450  49.470  14.850  57.500   5.890  65.000
 36.930  16.040  62.250    .320  47.870  14.940  58.510   3.680  73.800
 : RUNID 511363   APR 25, 1978
  5.591    5.597    5.605    5.632    5.652    5.676    5.700    5.728    5.752
  5.764    5.773    5.786    5.794    5.800    5.806    5.823    5.845    5.860
  5.873    5.868    5.861    5.861    5.859    5.858    5.854    5.852    5.852
  5.876    5.892    5.884    5.850    5.829    5.833    5.865    5.367    5.832
  5.827    5.846    5.869    5.898    5.918    5.935    5.937    5.913    5.902
  5.923    5.955    5.975    5.988    5.991    5.993    6.004
200
 48.090  14.620  57.210   1.100  43.400   3.430  13.040   1.220  65.000
 48.310  14.650  57.290   1.080  44.950   3.230  12.270   2.380  82.300
 48.520  14.600  57.120   1.060  44.520   3.050  11.940   2.250  79.600
 48.740  14.610  57.380   1.080  44.540   3.100  11.650   2.400  28.800
201
 49.810  14.540  57.210    .380  48.430   3.820  14.080   3.840  34.300
 50.030  14.490  57.300    .830  47.580   3.460  13.500   5.630  73.000
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(Continued)

Table H-1 (cont'd)

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 50.240  14.990  57.980    .480  47.870   3.240  12.620   3.560  46.200
 50.460  14.240  56.350    .650  44.960   3.220  12.300   3.150  42.900
202
 51.530  14.030  56.490    .310  44.390   4.250  16.160   2.890   3.000
 51.750  14.310  56.670    .590  45.180   4.130  15.290   3.530  13.100
 51.960  14.130  56.210    .740  48.120   3.770  14.540   3.900  29.900
 52.180  14.080  55.960   1.050  47.440   3.560  13.670   4.240  51.500
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511361
      36.4      63.5      82.9      19.1      97.91.9850E+041.3335E+08
      58.2      97.2      14.4      75.0 5.767E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511362
      36.4      63.5      82.9      19.3      98.32.0095E+041.2846E+08
      57.7      96.1      10.2      75.0 4.415E+00
PLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATAPLUME DATA
 511363
      36.4      63.5      83.3      18.8      97.71.9633E+041.2916E+08
      58.3      95.7       6.8      30.0 5.837E+00
```

Dwg. 7697A94

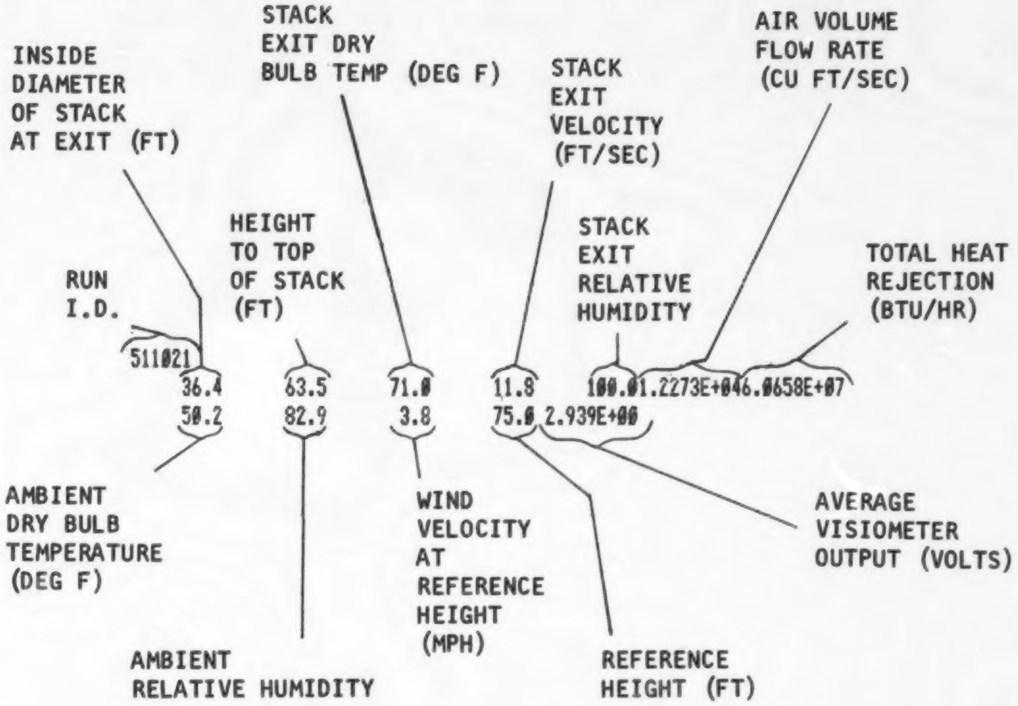
STACK EXIT DRY BULB TEMP (DEG F)
AIR VOLUME FLOW RATE (CU FT/SEC)
INSIDE DIAMETER OF STACK AT EXIT (FT)
STACK EXIT VELOCITY (FT/SEC)
HEIGHT TO TOP OF STACK (FT)
STACK EXIT RELATIVE HUMIDITY
TOTAL HEAT REJECTION (BTU/HR)
RUN I.D.
511021
36.4
63.5
71.0
11.8
100.01.2273E+046.0658E+07
50.2
82.9
3.8
75.0 2.939E+00
AMBIENT DRY BULB TEMPERATURE (DEG F)
WIND VELOCITY AT REFERENCE HEIGHT (MPH)
AVERAGE VISIOMETER OUTPUT (VOLTS)
AMBIENT RELATIVE HUMIDITY
REFERENCE HEIGHT (FT)

Figure I-1. Format of Data Prepared for Rubin's Program.

APPENDIX I

RUBIN'S PROGRAM AND INPUT DATA

The data for Rubin's program were extracted, sorted by test number, and assembled as an input file. A sample of the input data is given in Figure I-1.

Rubin's program was slightly modified to print out the test number and date for each test, and to calculate the visibility from the Visiometer data. However, no modifications were made, in any way, to the portions in which plume height and length were calculated. Rubin's program is listed in Table I-1, along with the plume input data file.

TABLE I-1

THE RUBIN PLUME PREDICTION COMPUTER CODE

```
C
C     ****************************************************************
C                     PLUME
C     PROGRAM TO CALCULATE VISIBLE PLUME CHARACTERISTICS
C     ****************************************************************
C
C     **** NOMENCLATURE ****
C
C     CLVIS = CALIBRATION VOLTAGE OF VISIOMETER (VOLTS)
C     CVIST = FACTORY CALIBRATION OF VISIOMETER (VOLTS)
C     DEGSAT=DEGREE OF SATURATION OF AMBIENT AIR (PERCENT)
C     D2=INSIDE DIAMETER OF STACK AT EXIT (FT)
C     F=BUOYANCY FLUX PARAMETER (FT**4/SEC**3)
C     G=FRAVITATIONAL ACCELERATION (32.2 FT/SEC**2)
C     GRADT = VERTIAL TEMP GRADIENT (DEG F/FT)
C     EFFLUX=AIR VOLUME FLOW RATE (CU FT/SEC)
C     H1=AMBIENT AIR ENTHALPY (BTU/LB DRY AIR)
C     MA=MOLECULAR WEIGHT OF DRY AIR
C     MW=MOLECULAR WEIGHT OF WATER VAPOR
C     NA1=MOLES OF DRY AIR IN AMBIENT AIR (LB MOLE/CU FT)
C     NAS1=MOLES OF DRY AIR IN SAT AIR AT DRY BULB TEMP (LB MOLE/CU FT)
C     NAS2=MOLES OF DRY AIR IN EFFLUENT AIR (LB MOLE/CU FT)
C     NW1=MOLES OF WATER VAPOR IN AMBIENT AIR (LB MOLE/CU FT)
C     NWS1=MOLES OF WATER VAP IN SAT AIR AT DRY BULB TEMP (LB MOLE/CU FT
C     NWS2=MOLES OF WATER VAPOR IN EFFLUENT AIR (LB MOLE/CU FT)
C     DRIP= DISTANCE OF POINT SOURCE UPWIND OF COOLING TOWER AXIS (FT)
C     PLUP= TOTAL LINGTH OF PLUME DOWNWIND FROM COOLING TOWER AXIS (FT)
C     PV=AMBIENT ATMOSPHERIC PRISSURE (ATM)
C     Q=WATER VAPOR RELEASE RATE (LB/HR)
C     R=GAS CONSTANT (0.7302 ATM CU FT/LB MOLE DEG RANKINE)
C     RA1=AMBIENT DENSITY OF DRY AIR (LB/CU FT)
C     RH=AMBIENT RELATIVE HUMIDITY (PERCENT)
C     RISE = PLUME RISE (FT)
C     RH2 =STACK EXIT RELATIVE HUMIDITY (PERCENT)
C     R01=AMBIENT DENSITY OF MOIST AIR (LB/CU FT)
C     RW1=AMBIENT DENSITY OF WATER VAPOR (LB/CU FT)
C     RWC3=DENSITY OF WATER VAPOR AT CONDENSATION POINT (LB/CU FT)
C     RWS2=EFFLUENT DENSITY OF WATER VAPOR (LB/CU FT)
C     RWS3=DENSITY OF WATER VAPOR AT REEVAPORATION POINT (LB/CU FT)
C     S=STABILITY PARAMETER (1/SEC**2)
C     SIGA=STANDARD DEVIATION OF THE AZIMUTH ANGLE AT SOURCE HEIGHT
C     SIGE=STANDARD DEVIATION OF THE ELEVATION ANGLE AT SOURCE HEIGHT
C     TCOND=CONDENSATION TEMPERATURE OF VAPOR PLUME (DEG F)
C     TDB=AMBIENT DRY BULB TEMPERATURE  (DEG F)
C     TEVAP=TEMPERATURE OF PLUME REEVAPORATION (DEG F)
```

(Continued)

Table I-1 (cont'd)

```
C     THR = TOTAL HEAT REJECTION OF TOWER (BTU/HR)
C     TOTP=TOTAL LENGTH OF PLUME DOWNWIND FROM POINT SOURCE (FT)
C     TOUT=STACK EXIT DRY BULB TEMPERATURE (DEG F)
C     TVIS=SAT TEMP CORRESPONDING TO MINIMUM PLUME VISIBILITY (DEG F)
C     UH=WIND SPEED AT TOP OF TOWER  (MPH)
C     UO=WIND SPEED AT REFERENCE HEIGHT ZO(MPH)
C     VISIB = VISIBILITY CALCULATED FROM PLUME THEORY (FEET)
C     VISOB = VISIBILITY FROM VISIOMETER DATA
C     VOUT=EXIT VELOCITY (FT/SEC)
C     VVISO = VISIOMETER OUTPUT (VOLTS)
C     W1=AMBIENT HUMIDITY RATIO (LB H20/LB DRY AIR)
C     WCONT=MAX. LIQUID WATER CONTENT OF VISIBLE PLUME (GRAMS/CU METER)
C     WS1=SAT HUMIDITY RATIO AT AMBIENT TEMP (LB WATER/LB DRY AIR)
C     WS2= HUMIDITY RATIO AT EFFLUENT TEMP (LB WATER/LB DRY AIR)
C     WS2SAT=SAT HUMIDITY RATIO AT EFFLUENT TEMP (LB WATER/LB DRY AIR)
C     WS3=SAT HUMIDITY RATIO AT REEVAPORATION ATEMP (LB WATER/LB DRY AIR)
C     WSC=SAT HUMIDITY RATIO AT CONDENSATION TEMP (LB WATER/LB DRY AIR)
C     XNWS1=MOLE FRACTION OF WATER VAPOR IN SAT AIR AT AMBIENT TEMP
C     ZH=HEIGHT TO TOP OF STACK (FT)
C     ZO=REFERENCE HEIGHT FOR WIND SPEED (FT)
C
C     **** INPUT PARAMETERS ****
C
C     D2, FEET
C     ZH, FEET
C     TDB, DEG F
C     RH, PERCENT
C     UO, MPH
C     ZO, FEET
C     VOUT, FT/SEC
C     TOUT, DEG F
C     RH2, PERCENT
C     EFFLUX, CU FT/SEC
C     THR, BTU/HR
C     VVISO, VOLTS
C
C     *******************************************************************
C
      REAL MA,MW,NAS1,NWS1,NA1,NW1,NAS2,NWS2
1     CONTINUE
1003  FORMAT (72H0123456789012345678901234567890123456789012345678901234
     +567890123456789O1   )
      READ (5,1003)
1004  FORMAT (1H1)
      WRITE (6,1004)
      WRITE (6,1003)
1000  FORMAT (5F10.3,2E10.6)
      READ(5,1000) D2,ZH,TOUT,VOUT,RH2,EFFLUX,THR
      IF  (D2.EQ.0.) GO TO 2
1002  FORMAT (4F10.3, E10.6)
      READ (5,1002) TDB, RH, UO, ZO, VVISO
```

(Continued)

Table I-1 (cont'd)

```
 99   FORMAT (1H-)
      WRITE(6,99)
 800  FORMAT (1H-,24X,'A CODE FOR CALCULATING COOLING TOWER  VISIBLE',
     +      ' PLUME ',
     +'CHARACTERISTICS'//17X'CALCULATIONS ARE BASED ON AN ATMOSPHERIC PR
     +ESSURE OF 29.921 INCHES OF MERCURY  '///50X'INPUT DATA'///45X'METE
     +OROLOGICAL INPUT'//5X'AMBIENT DRY BULB TEMPERATURE =',F8.3,' DEC.
     + F.'/5X'AMBIENT RELATIVE HUMIDITY =',F8.3,' PERCENT'/5X
     + 'WIND SPEED =',F8.3,' MPH AT REFERENCE HEIGHT'/
     +5X'REFERENCE HEIGHT FOR WIND SPEED =',F8.3,' FEET ABOVE GROUND'/
     +//45X'COOLING TOWER INPUT'/5X,'HEIGHT OF COOLING TOWER =',F8.3,
     +' FT'/5X,'INSIDE STACK DIA. AT EXIT ='  ,F8.3,' FT'/5X,'TOTAL HEAT
     + TRANSFER RATE FROM WATER TO AIR =',E11.3,' BTU/HR'/5X,
     +    'AIR VOLUME FLOW RATE =',E13.4,' CU FT/SEC',
     +/5X,'EFFLUENT EXIT VELOCITY =',F10.3,' FT/SEC'/5X,'EFFLUENT AIR TE
     +MPERATURE =',F8.3,' DEC F'/5X,'EFFLUENT RELATIVE HUMIDITY =',F6.2
     +,' PERCENT')
 1005  FORMAT(5X,'VISIOMETER OUTPUT = ',F8.4,' VOLTS' )
       WRITE(6,800) TDB,RH,UO,ZO,ZH,D2,THR,EFFLUX,VOUT,TOUT,RH2
       WRITE (6,1005) VVISO
       WRITE(6,1003)
       MA=28.966
       MW=18.016
       PI=3.14159
       PV=1.0
       R=0.7302
       RH=RH/100.0
       T1=TDB+459.67
       G=32.2
       CLVIS = 0.11
       CVIST = 1.1
C
C      *************************************************************
C      CALCULATES AMBIENT AIR THERMODYNAMIC PROPERTIES
C      *************************************************************
C
       WS1=RATIO(TDB)
       NAS1=(PV/(R*T1))/(1.0+WS1*MA/MW)
       NWS1=WS1*NAS1*MA/MW
       XNWS1=NWS1/(NAS1+NWS1)
       DEGSAT=(1.0-XNWS1)*RH/(1.0-RH*XNWS1)*100.0
       W1=WS1*DEGSAT/100.0
       NA1=(PV/(R*T1))/(1.0+W1*MA/MW)
       NW1=W1*NA1*MA/MW
       RW1=NW1*MW
       RA1=NA1*MA
       RO1=RA1+RW1
       H1=TDB*(0.240+W1*0.444)+1061.0*W1
       WRITE(6,99)
       WRITE(6,1004)
```

(Continued)

Table I-1 (cont'd)

```
      WRITE(6,1003)
      WRITE(6,850) DEGSAT,W1,RA1,RW1,RO1,H1
850   FORMAT (51X'OUTPUT DATA'///45X'AMBIENT AIR CONDITION'//5X,
     +'AMBIENT DEGREE OF SATURATION =',F8.3,' PERCENT' /5X'AMBIENT HUMID
     +ITY RATIO =',F12.9,' LB. WATER PER LB. DRY AIR' /5X'AMBIENT DENSIT
     +Y OF DRY AIR =',F12.9,' LB. DRY AIR PER CU. FT.' /5X'AMBIENT DENSI
     +TY OF WATER VAPOR =',F12.9,' LB. WATER PER CU. FT.' /5X'AMBIENT DE
     +NSITY OF MOIST AIR =',F12.9,' LB. PER CU. FT.' /5X'AMBIENT AIR ENT
     +HALPY =',F9.5,' BTU. PER LB. DRY AIR')
C
C      **************************************************************
C      COOLING TOWER EFFLUENT PROPERTIES
C      **************************************************************
C
      WS2SAT=RATIO (TOUT)
      WS2=RH2*WS2SAT/100.
      T2=TOUT+459.67
      NAS2=(PV/(R*T2))/(1.0+WS2*MA/MW)
      NWS2=WS2*NAS2*MA/MW
      RWS2=NWS2*MW
      Q=(RWS2-RW1)*EFFLUX*3600.0
      WRITE(6,852) WS2,RWS2,Q
852   FORMAT (1H-,44X,'TOWER EFFLUENT CONTITION'//5X,'EFFLUENT HUMIDITY
     +RATIO =',F12.9,'LB WATER/LB DRY AIR'/5X,'EFFLUENT DENSITY OF WATER
     + VAPOR =',F12.9,'LB WATER/CU FT'/5X,'WATER VAPOR RELEASE =',E12.4,
     +' LB WATER PER HOUR')
C
C      **************************************************************
C      CALCULATES THERMODYNAMIC PROPERTIES AT PLUME CONDENSATION
C      **************************************************************
C
      IF (RH2.EQ.100.) GO TO 35
      TCOND=TOUT
5     TCOND = TCOND-0.1
      WSCA=WS2-(TOUT-TCOND)*(WS2-W1)/(TOUT-TDB)
      WSCB=RATIO(TCOND)
      IF (TDB.GE.TCOND) GO TO 10
      IF (WSCB-WSCA)  10,10,5
10    TCOND=TCOND+.0001
      IF (TDB.GE.TCOND) GO TO 10
      WSCA=WS2-(TOUT-TCOND)*(WS2-W1)/(TOUT-TDB)
      WSCB=RATIO(TCOND)
      IF (WSCB-WSCA) 10,10,15
15    IF (TCOND .GT. TOUT) TCOND = TOUT
      WSC=RATIO(TCOND)
      T3=TCOND+460.
      RWC3=(WSC*MW)/((MW/MA+WSC)*R*T3)
      WRITE (6,30) TCOND,WSC,RWC3
30    FORMAT(///36X'CONDENSATION CONDITIONS OF FOG PLUME'//5X' TEMPERATU
     +RE OF CONDENSATION =',F8.3,' DEG F'/5X'HUMIDITY RATIO AT CONDENSAT
     +ION =',F12.9,' LB WATER PER LB DRY AIR' /5X'DENSITY OF WATER VAPOR
     + AT CONDENSATION =',F12.9,' LB WATER PER CU FT')
```

(Continued)

Table I-1 (cont'd)

```
      GO TO 45
35    WSC=RATIO(TOUT)
      TCOND = TOUT
      WRITE (6,40)
40    FORMAT (//5X'COOLING TOWER EXHAUST IS SATURATED')
45    CONTINUE
C
C     *****************************************************************
C     CALCULATES THERMODYNAMIC PROPERTIES OF THE PLUME AT REEVAPORATION
C     *****************************************************************
C
      TEVAP=TDB
11    TEVAP=TEVAP+0.1
      WS3A=WS2-(TOUT-TEVAP)*(WS2-W1)/(TOUT-TDB)
      WS3B=RATIO(TEVAP)
      IF (TEVAP .GE. TOUT) GO TO 12
      IF (WS3A-WS3B) 11,11,12
12    TEVAP=TEVAP-0.0001
      IF (TEVAP .GE. TOUT) GO TO 12
      WS3A=WS2-(TOUT-TEVAP)*(WS2-W1)/(TOUT-TDB)
      WS3B=RATIO(TEVAP)
      IF (WS3A-WS3B) 13,13,12
13    IF (TEVAP .LT. TDB) TEVAP = TDB
      IF (TEVAP-TCOND) 14,17,17
17    WRITE (6,29)
29    FORMAT (/// 15X ' NO VISIBLE PLUME PREDICTED BY PLUME MODEL')
      WRITE (6,1006) VISOP
      GO TO 27
14    WS3=RATIO(TEVAP)
      T3=TEVAP+459.67
      RWS3=(WS3*MW)/((MW/MA+WS3)*R*T3)
      WRITE(6,853) TEVAP,WS3,RWS3
853   FORMAT (///36X'REEVAPORATION CONDITIONS OF FOG PLUME'//5X' TEMPERA
     +TURE OF REEVAPORATION =',F8.3,' DEG. F.' /5X' HUMIDITY RATIO AT RE
     +EVAPORATION =',F12.9,' LB. WATER PER LB. DRY AIR' /5X' DENSITY OF
     + WATER VAPOR AT REEVAPORATION =',F12.9,' LB. WATER PER CU. FT.')
C
C     *****************************************************************
C     CALCULATES PLUME VISIBILITY
C     *****************************************************************
C
      VISOP = (CLVIS/CVIST)*(39.0/VVISO)*(3.2808)
1006  FORMAT (6X,'VISIBILITY FROM VISIOMETER = ',F10.4,' FEET'  )
      WRITE (6,1006) VISOP
      WRITE(6,1003)
      DELWA=0.
      TVIS=TEVAP
110   TVIS=TVIS+.1
      WS3S=RATIO(TVIS)
      HSAT=TVIS*(0.240+WS3S*0.444)+1061.* WS3S
```

(Continued)

Table I-1 (cont'd)

```
      CON1=(TOUT-TEVAP)/(WS2-WS3)
      CON2=(2389.6+TEVAP)/CON1 + 0.5405 - WS3
      CON3=(.5405*TEVAP-2.252*HSAT)/CON1 - 0.5405*WS3
      WS3M=((CON2**2.-4.0*CON3)**0.5-CON2)/2.0
      DELWB=WS3M-WS3S
      IF (DELWB.LE.0.) GO TO 120
      IF (DELWA-DELWB) 112,112,114
  112 DELWA=DELWB
      GO TO 110
  114 DELWA=DELWB
  117 TVIS=TVIS-.0001
      WS3S=RATIO(TVIS)
      HSAT = TVIS*(0.240 + WS3S*0.444) + 1061.0*WS3S
      CON1=(TOUT-TEVAP)/(WS2-WS3)
      CON2=(2389.6+TEVAP)/CON1 + 0.5405 - WS3
      CON3=(.5405*TEVAP-2.252*HSAT)/CON1 - 0.5405*WS3
      WS3M=((CON2**2.-4.0*CON3)**0.5-CON2)/2.0
      DELWB=WS3M-WS3S
      IF (DELWA/DELWB) 116,118,118
  116 DELWA=DELWB
      GO TO 117
  120 WRITE(6,854)
  854 FORMAT (///5X,' NO VISIBLE PLUME')
      GO TO 135
  118 RWDEL=(DELWB*MW)/((MW/MA+DELWB)*R*(TVIS+460.))
      WCONT=RWDEL*1.6E4
      VISIB=(177.24/WCONT**.69)/4.5
      WRITE(6,1004)
      WRITE(6,1003)
      WRITE (6,849)
  849 FORMAT ( 1X,36X,' PLUME DATA'/)
      WRITE(6,855) TVIS,WCONT,VISIB
  855 FORMAT(///5X,' TEMP AT MAX OPACITY =',F10.2,' DEG F'/5X,
     1' LIQUID WATER CONTENT =',F10.5,' GRAMS/CUBIC METER'/,5X,
     2' VISIBILITY =',F7.0,' FT'/)
  135 CONTINUE
      IF ((RWS3-RW1) .LE. 0.0) GO TO 27
      IF (UO .LE. 0.0) GO TO 27
C
C     ******************************************************************
C     CALCULATES PLUME RISE
C     ******************************************************************
C
      UH = UO*(ZH/ZO)**0.5
      WRITE(6,856) UH
  856 FORMAT(///,5X,' WIND SPEED AT TOP OF STACK =',F8.2,' MPH'///5X,
     +' VERTICAL TEMPERATURE GRADIENT (DEG F/FT)',5X,'PLUME RISE (FT)'
     +/)
      F=G*VOUT*(D2/2.)**2.*(TOUT-TDB)/(TOUT+460.)
      GRADT=-.004
```

(Continued)

Table I-1 (cont'd)

```
      DO 25 I=1,5
      S=G*(GRADT+.0054)/(TOUT+460.)
      IF (UH.LE.5.0) GO TO 22
      RISE=2.9*(F/(UH*1.467*S))**(1./3.)
      GO TO 23
22    RISE=5.*F**.25/S**.375
23    WRITE(6,857) GRADT,RISE
857   FORMAT(5X,F16.4,24X,F16.0)
      GRADT=GRADT+.002
25    CONTINUE
C
C     ******************************************************************
C     CALCULATES PLUME LENGTH DURING STABLE CONDITIONS
C     ******************************************************************
C
       SIGA=2.0
       SIGE=0.2*SIGA
       DEN=.15
       POW=.71
       M=0
 50    CON=(RWS3-RW1)
       TOTP=3.281*(Q*.3048**2./(5280.*2.*PI*UH*SIGA*SIGE*CON*DEN**2.))
     +  **(1./(2.*POW))
       CON=(RWS2-RW1)
       ORIP=3.281*(Q*.3048**2./(5280.*2.*PI*UH*SIGA*SIGE*CON*DEN**2.))
     +  **(1./(2.*POW))
       PLUP=TOTP-ORIP
      IF(PLUP.LE.0.) PLJP=0.
      IF (M.GT.0) GO TO 60
       PRINT 99
      WRITE(6,858)
 858  FORMAT(20X,' VISIBLE PLUME LENGTH (FT)'///)
      WRITE(6,859) PLUP
 859  FORMAT(5X,' STABLE CONDITIONS:',F8.0,F14.0)
C
C      ******************************************************************
C      CALCULATES PLUME LENGTH DURING UNSTABLE CONDITIONS
C      ******************************************************************
C
 16    UH=UO*(ZH/ZO)**0.25
       SIGA=((23.0/(UH*0.44704))+4.75)/((ZH*0.3048/100.0)**0.25)
       SIGE=0.7*SIGA
        DEN=.045
        POW=.86
        M=1
        GO TO 50
 60    CONTINUE
       WRITE(6,860) PLUP
```

(Continued)

Table I-1 (cont'd)

```
      860   FORMAT(5X,' UNSTABLE CONDITIONS=',F6.0)
            WRITE(6,1003)
      27    CONTINUE
            GO TO 1
      2     CONTINUE
             STOP
             END
       4     RATIO=C1+C2*T+C3*T**2+C4*T**3+C5*T**4+C6*T**5+C7*T**6
            RETURN
            END
            FUNCTION RATIO(T)
       C
       C     *****************************************************************
       C     A POLYNOMIAL THAT DETERMINES THE HUMIDITY RATIO OF SATURATED AIR
       C     AS A FUNCTION OF TEMPERATURE (FOR TEMPERATURES OF 0 TO 125 DEG F)
       C     BASED ON TABLES OF THERMODYNAMIC PROPERTIES OF MOIST AIR AS DETER-
       C     MINED BY GOFF AND CRATCH (ASHVE TRANS., VOL. 51, 1945, P. 125)
       C     *****************************************************************
       C
       C
            IF (T.GT.-2.0) GO TO 5
            C1 = 7.88344E-4
            C2=  4.2135E-5
            C3 = 1.24636E-6
            C4 = 5.04627E-8
            C5 = 2.74396E-9
            C6 = 9.31737E-11
            C7 = 1.27561E-12
            GO TO 4
      5     IF (T .GT. 26.0) GO TO 1
            C1=7.87148906E-4
            C2=4.15298677E-5
            C3=8.65035077E-7
            C4=3.52082886E-8
            C5=-1.29388122E-9
            C6=4.55358567E-11
            C7=-5.02345817E-13
            GO TO 4
      1     IF (T .GT. 42.0) GO TO 2
            C1=-3.11191294E-2
            C2=8.60153427E-3
            C3=-8.48560098E-4
            C4=4.18583192E-5
            C5=-1.10219813E-6
            C6=1.49087715E-8
            C7=-8.15425514E-11
            GO TO 4
      2     IF (T .GT. 70.0) GO TO 3
            C1=-7.51979670E-2
```

(Continued)

Table I-1 (cont'd)

```
          C2=8.59811756E-3
          C3=-3.96707900E-4
          C4=9.79992181E-6
          C5=-1.34485316E-7
          C6=9.80275702E-10
          C7=-2.94869850E-12
          GO TO 4
    3     C1 = 8.30323558E-2
          C2=-5.65971702E-3
          C3=1.65284898E-4
          C4=-2.50820357E-6
          C5=2.18423884E-8
          C6=-1.00364018E-10
          C7=2.00884394E-13
```

```
: RUNID 511011   MAR 23, 1978      DAY OF YEAR 082
   36.4       63.5       73.1       9.0      100.09.3812E+033.1496E+07
   38.5       92.5        2.6      75.0 3.646E+00
: RUNID 511012   MAR 23, 1978      DAY OF YEAR 082
   36.4       63.5       73.7       8.4      100.08.7847E+033.0922E+07
   41.7       89.2        1.6      75.0 3.708E+00
: RUNID 511013   MAR 23, 1978      DAY OF YEAR 082
   36.4       63.5       74.5       8.5      100.08.8741E+033.0913E+07
   43.2       88.6         .7      30.0 5.280E+00
: RUNID 511021   MAR 23, 1978      DAY OF YEAR 082
   36.4       63.5       71.0      11.8      100.01.2273E+046.0658E+07
   50.2       82.9        3.8      75.0 2.939E+00
: RUNID 511022   MAR 23, 1978      DAY OF YEAR 082
   36.4       63.5       71.3      12.3      100.01.2769E+045.9784E+07
   53.3       81.4        2.5      75.0 1.942E+00
: RUNID 511061   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       64.5      19.0      100.01.9826E+041.8188E+08
   33.5       98.5        6.7      75.0 2.147E+00
: RUNID 511062   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       69.5      19.7      100.02.0521E+042.1804E+08
   38.0       90.9        1.4      75.0 2.993E+00
: RUNID 511063   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       70.4      19.3      100.02.0100E+042.0450E+08
   38.2       93.3        4.2      30.0 3.226E+00
: RUNID 511071   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       73.7       9.5       98.59.9018E+037.7810E+07
   47.8       83.6        8.2      75.0 3.394E-02
: RUNID 511072   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       71.8       9.4       94.59.7856E+036.2056E+07
   50.0      100.0       11.8      75.0-6.994E-02
: RUNID 511073   MAR 28, 1978      DAY OF YEAR 087
   36.4       63.5       72.0      11.0       89.01.1414E+045.8500E+07
   51.4       81.9        6.7      30.0-8.035E-02
: RUNID 511081   APR  4, 1978      DAY OF YEAR 094
   36.4       63.5       77.2      13.6      100.01.4135E+041.0642E+08
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(Continued)

Table I-1 (cont'd)

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      49.0      97.0        2.5       75.0 3.909E-01
   : RUNID 511082   APR  4, 1978       DAY OF YEAR 094
      36.4      63.5       76.1       13.2      100.01.3706E+049.8282E+07
      50.1      96.3        4.4       75.0 1.637E-01
   : RUNID 511083   APR  4, 1978       DAY OF YEAR 094
      36.4      63.5       75.9       13.2      100.01.3790E+049.8996E+07
      51.0      99.1        2.3       30.0 1.570E-01
   : RUNID 511121   APR  4, 1978       DAY OF YEAR 094
      36.4      63.5       68.5       19.2      100.01.9979E+049.6281E+07
      52.5     100.0        2.7       75.0 9.327E-02
   : RUNID 511122   APR  4, 1978       DAY OF YEAR 094
      36.4      63.5       68.2       19.4      100.02.0172E+048.8680E+07
      53.5      99.6        3.9       75.0 6.762E-02
   : RUNID 511123   APR  4, 1978       DAY OF YEAR 094
      36.4      63.5       68.8       19.8      100.02.0578E+048.9879E+07
     128.4      79.0       12.7       75.0 6.421E-02
   : RUNID 511131   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       75.1        9.4       92.59.7681E+035.2596E+07
      46.3      95.2        5.1       75.0 5.831E+00
   : RUNID 511132   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       79.2        9.3       93.09.7276E+035.9493E+07
      47.0      95.1        3.8       75.0 5.808E+00
   : RUNID 511133   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       81.4        9.4       91.79.7871E+036.4608E+07
      47.9      94.8        4.6       30.0 5.490E+00
   : RUNID 511141   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       81.4       12.9       87.61.3395E+047.9467E+07
      53.2      89.4        4.2       75.0 4.852E+00
   : RUNID 511142   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       82.6       13.3       87.01.3880E+047.9205E+07
      56.2      88.0        4.4       75.0 4.849E+00
   : RUNID 511143   MAY 11, 1978       DAY OF YEAR 131
      36.4      63.5       83.4       13.6       86.81.4214E+047.6955E+07
      58.4      88.6        2.3       30.0 4.348E+00
   : RUNID 511181   MAY 12, 1978       DAY OF YEAR 132
      36.4      63.5       68.1       20.2       92.82.1026E+047.7374E+07
      50.6      98.9        5.5       75.0 4.603E+00
   : RUNID 511182   MAY 12, 1978       DAY OF YEAR 132
      36.4      63.5       70.2       19.7       91.02.0565E+048.5675E+07
      52.2      97.6        3.5       75.0 4.109E+00
   : RUNID 511183   MAY 12, 1978       DAY OF YEAR 132
      36.4      63.5       71.2       19.9       91.42.0767E+048.9647E+07
      52.9      97.1        3.4       30.0 3.252E+00
   : RUNID 511201   MAY 17, 1978       DAY OF YEAR 137
      36.4      63.5       74.8       13.5       90.21.4077E+047.1948E+07
      45.8      98.0        4.1       75.0 5.556E+00
   : RUNID 511202   MAY 17, 1978       DAY OF YEAR 137
      36.4      63.5       75.8       13.5       89.51.4106E+047.9971E+07
      45.9      98.2        4.3       75.0 5.044E+00
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(Continued)

Table I-1 (cont'd)

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: RUNID 511203   MAY 17, 1978      DAY OF YEAR 137
   36.4      63.5      77.6      13.6      87.21.4115E+048.0266E+07
   48.5      97.0       2.3      30.0 4.814E+00
: RUNID 511241   MAY 17, 1978      DAY OF YEAR 137
   36.4      63.5      74.1      19.7      85.82.0490E+041.0319E+08
   52.2      94.8       1.7      75.0 1.773E+00
: RUNID 511242   MAY 17, 1978      DAY OF YEAR 137
   36.4      63.5      75.6      19.7      85.02.0537E+041.0136E+08
   55.1      93.0       1.9      75.0 1.412E+00
: RUNID 511243   MAY 17, 1978      DAY OF YEAR 137
   36.4      63.5      76.5      19.9      84.42.0682E+041.0213E+08
   56.6      92.5       1.9      30.0 1.216E+00
: RUNID 511251   MAR 30, 1978      DAY OF YEAR 089
   36.4      63.5      78.6       7.9      96.38.2146E+033.2486E+07
   53.4      74.9       3.0      75.0 7.313E-01
: RUNID 511252   MAR 30, 1978      DAY OF YEAR 089
   36.4      63.5      79.0       7.8      95.68.1432E+033.2253E+07
   55.1      71.6       4.4      75.0 6.852E-02
: RUNID 511253   MAR 30, 1978      DAY OF YEAR 089
   36.4      63.5      80.5       7.7      94.38.0142E+033.9168E+07
   56.1      70.9       5.0      30.0 4.048E-01
: RUNID 511272   MAR 18, 1978      DAY OF YEAR 077
   36.4      63.5      65.2      32.1     100.03.3471E+041.6811E+08
   36.5      72.0        .0      75.0 1.433E+00
: RUNID 511273   MAR 18, 1978      DAY OF YEAR 077
   36.4      63.5      65.9      31.8     100.03.3151E+041.7233E+08
   37.2      71.4        .1      30.0 1.231E+00
: RUNID 511301   MAR 18, 1978      DAY OF YEAR 077
   36.4      63.5      64.6      31.7     100.03.2975E+041.6934E+08
   37.2      71.3      11.1      75.0 1.217E+00
: RUNID 511311   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      91.2       8.5     100.08.8596E+035.2071E+07
   57.2      97.2      10.1      75.0 4.402E+00
: RUNID 511312   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      91.2       8.7      99.99.1053E+035.3502E+07
   57.3      97.2       7.2      75.0 4.001E+00
: RUNID 511313   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      91.2       8.5     100.08.8647E+035.9054E+07
   57.9      96.5       7.9      30.0 9.834E-01
: RUNID 511321   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      88.1      12.2      99.31.2685E+048.8306E+07
   57.8      96.9      12.6      75.0 5.497E+00
: RUNID 511322   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      87.5      12.2      99.31.2673E+048.5993E+07
   57.3      96.6      11.8      75.0 4.027E+00
: RUNID 511323   APR 25, 1978      DAY OF YEAR 115
   36.4      63.5      87.1      12.1     100.01.2606E+048.9300E+07
   57.7      96.5       6.4      30.0 4.323E+00
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(Continued)

Table I-1 (cont'd)

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: RUNID 511361   APR 25, 1978      DAY OF YEAR 115
   36.4       63.5       82.9      19.1       97.91.9850E+041.3335E+08
   58.2       97.2       14.4      75.0 5.767E+00
: RUNID 511362   APR 25, 1978      DAY OF YEAR 115
   36.4       63.5       82.9      19.3       98.32.0095E+041.2846E+08
   57.7       96.1       10.2      75.0 4.415E+00
: RUNID 511363   APR 25, 1978      DAY OF YEAR 115
   36.4       63.5       83.3      18.8       97.71.9633E+041.2916E+08
   58.3       95.7        6.8      30.0 5.837E+00
: RUNID 511371   APR 27, 1978      DAY OF YEAR 117
   36.4       63.5       86.1       9.2       97.39.5857E+037.7000E+07
   49.7       81.1       16.2      75.0 8.409E-01
: RUNID 511372   APR 27, 1978      DAY OF YEAR 117
   36.4       63.5       87.1       9.3       95.69.6640E+034.9317E+07
   51.3       79.6       11.8      30.0 1.033E+00
: RUNID 511421   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       78.7      18.7       93.31.9433E+041.0711E+08
   56.7       93.7        4.6      75.0 5.168E+00
: RUNID 511422   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       78.0      18.7       92.81.9511E+049.4087E+07
   58.6       92.6        2.8      75.0 4.840E+00
: RUNID 511431   APR 28, 1978      DAY OF YEAR 118
   36.4       63.5       88.0       9.2       90.79.5366E+036.0603E+07
   58.3       77.0        5.9      75.0 1.234E+00
: RUNID 511432   APR 28, 1978      DAY OF YEAR 118
   36.4       63.5       88.0       9.6       91.49.9497E+032.8914E+07
   59.7       73.8       13.9      75.0 3.823E-01
: RUNID 511433   APR 28, 1978      DAY OF YEAR 118
   36.4       63.5       89.0       9.7       88.91.0137E+044.1583E+07
   60.9       73.5       12.4      30.0 1.661E+00
: RUNID 511441   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       84.3      12.8       94.71.3341E+048.2563E+07
   51.3       97.3        4.0      75.0 6.103E+00
: RUNID 511442   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       84.1      13.2       94.91.3706E+047.7235E+07
   52.8       96.6        2.7      75.0 5.794E+00
: RUNID 511443   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       83.0      12.7       94.91.3197E+047.9174E+07
   53.6       95.7        6.2      30.0 2.956E+00
: RUNID 511481   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       75.8      19.1       92.61.9900E+041.0164E+08
   47.8       98.1        3.3      75.0 6.246E+00
: RUNID 511482   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       77.3      19.4       93.12.0193E+041.1166E+08
   49.7       96.8        5.2      75.0 6.229E+00
: RUNID 511483   MAY 18, 1978      DAY OF YEAR 138
   36.4       63.5       78.6      18.9       92.81.9655E+041.1077E+08
   48.8       99.3        3.3      30.0 5.737E+00
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TABLE J-1

COMPARISON OF PREDICTED AND OBSERVED PLUME CHARACTERISTICS

Test No.	Gradient (°F/ft)	Computed Height (ft)	Computed Length (ft)	Computed Visibility (ft)	Measured Height (ft)	Measured Length (ft)	Measured Visibility (ft)
511011	+.0538	<732	4255	49	156.97	108.09	3.51
			Thin broken cirrocumulus				
511012	+.0492	<706	3558	57	160.76	76.22	3.45
511013	+.0179	<704	4183	60	166.63	47.22	2.42
			Thin broken cirrostratus				
511021	+.00455	690	468	206	107.8	9.7	4.41
			Thin broken stratus				
511022	+.0132	<672	268	554	66.1	3.6	6.6
511061	+.051	<383	10804	55	253.3	132.4	6.0
			Clear				
511062	+.03	<870	8173	59	291.8	185.0	4.3
511063	+.113	<391	3612	55	277.4	115.2	4.0
			Clear				
511071	-.0078	>504	23	121	44.3	15.9	377.0
			Clear				
511072	-.008	>420	17154	131	38.9	8.4	∞
511073	--	0	0	∞	19.5	13.18	∞
			Clear				

(Continued)

APPENDIX J

COMPARISON OF COMPUTED AND OBSERVED PLUME PARAMETERS

This appendix contains a tabulation of computed and observed plume parameters, tabulated by test number and data. Vertical temperature gradients and cloud cover are also tabulated.

Table J-1 (cont'd)

Test No.	Gradient (°F/ft)	Computed Height (ft)	Computed Length (ft)	Computed Visibility (ft)	Measured Height (ft)	Measured Length (ft)	Measured Visibility (ft)
511081	+.042	<772	7722	61	175.8	6.0	32.7
			Overcast stratiform				
511082	+.010	<751	3679	70	231.4	3.0	78.2
511083	.0017	813	11659	70	236.0	2.2	81.5
			Overcast stratus				
511121	-.002	798	37787	127	220.2	3.1	137.2
			Overcast stratus				
511122	-.0024	1048	226	148	204.5	2.8	189.2
511123	-		0	∞		3.0	>199
			Overcast stratus				
511131	+.069	<708	1933	103	105.2	36.5	2.2
			Thin scattered cirriform				
511132	+.0807	<726	3085	73	117.9	29.8	2.2
511133	+.042	<302	1926	72	125.1	19.3	2.3
			Clear				
511141	+.050	0	0	∞	97.7	5.0	2.6
			Clear				
511142	+.0273	0	0	∞	86.9	4.6	2.6

(Continued)

Table J-1 (cont'd)

Test No.	Gradient (°F/ft)	Computed Height (ft)	Computed Length (ft)	Computed Visibility (ft)	Measured Height (ft)	Measured Length (ft)	Measured Visibility (ft)
511143	+.0125	0	0	∞	66.8	4.3	2.9
			Clear				
511181	+.0314	<345	2177	963	217.4	13.4	2.8
			Thin broken cirrostratus				
511182	+.0289	0	0	∞	189.2	12.6	3.1
511183	+.0302	0	0	∞	158.8	13.4	3.9
			Thin broken cirrus				
511201	+.0403	<776	5514	106	256.9	3.5	2.3
			Clear				
511202	+.0423	<782	6041	102	257.2	4.7	2.54
511203	+.010	<779	3456	164	252.0	10.5	2.7
			Clear				
511241	+.0438	0	0	∞	178.2	3.1	7.2
			Clear				
511242	+.0201	0	0	∞	139.6	2.2	9.1
511243	+.004	0	0	∞	108.8	.85	10.5
			Clear				
511251(089)	+.003	0	0	∞	39.0	31.0	17.5
			Clear				

(Continued)

Table J-1 (cont'd)

Test No.	Gradient (°F/ft)	Computed Height (ft)	Computed Length (ft)	Computed Visibility (ft)	Measured Height (ft)	Measured Length (ft)	Measured Visibility (ft)
511252(089)	-.002	0	0	∞	31.7	14.09	186.79
511253(089)	-.002	0	0	∞	29.66	17.17	31.61
			Clear				
511272	-	-	-	100.0	-	-	-
511273	-	-	-	101.0	-	-	-
511301(077)	-.004	694	622	117	78.5	21.8	10.5
511311(115)	-.0086	>496	149	44	163.1	17.5	2.9
			Overcast stratiform				
511312(115)	-.00763	>559	146	45	185.6	239.4	45.0
511313(115)	+.00259	260	1999	46	186.2	244.9	13.0
			Overcast stratiform				
511321	-.00201	372	2332	55	130.0	125.9	2.3
			Overcast stratus				
511322	-.0049	511	132	56	129.4	114.4	3.2
511323	-.0022	392	2387	56	141.2	143.4	3.0
			Overcast stratus				
511361	+.0015	310	2037	85	161.2	101.6	2.2
			Overcast stratus				
511362	+.0187	<312	2115	83	125.9	159.24	2.9
511363	-.00914	>572	96	90	106.83	181.51	2.2
			Overcast stratus				

(Continued)

Table J-1 (cont'd)

Test No.	Gradient (°F/ft)	Computed Height (ft)	Computed Length (ft)	Computed Visibility (ft)	Measured Height (ft)	Measured Length (ft)	Measured Visibility (ft)
511371	+.00409	236	503	56	43.8	82.8	15.2
Scattered cirrostratus							
511372	-.003326	372	35	67	44.00	86.46	12.39
511421	+.00345	0	0	∞	112.7	56.9	2.5
Overcast altocumulus							
511422	-.000168	0	0	∞	96.6	49.3	2.6
511431	-.0034	0	0	∞	47.7	33.6	10.4
Scattered cirrus							
511432	-.0063	0	0	∞	43.9	34.9	33.5
511433	-.0032	0	0	∞	36.4	23.2	7.7
Clear							
511441	+.0401	<793	6430	59	214.1	72.8	2.1
Overcast cirrocumulus							
511442	+.0109	<788	6448	66	196.2	71.4	2.2
511443	+.0072	<289	1819	78	169.8	68.3	4.3
Overcast cirrocumulus							
511481	+.061	<839	8656	95	218.2	83.7	2.0
Clear							
511482	+.044	<840	4038	101	227.0	90.0	2.0
511483	+.0155	<851	15152	77	203.7	80.4	2.2
Clear							